Africa RISING East and Southern Africa Project

2018/2019 Workplan

March 2019

www.africa-rising.net

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-in-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program's monitoring, evaluation and impact assessment. http://africa-rising.net/

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Contents

Outcomes, outputs and activities of the Africa RISING East and Southern Africa

Table 1: Outcomes, outputs and activities of the Africa RISING ESA project

Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets.	
Output 1.1: Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies and scaled in Outcomes 4 and 5	Activity 1.1.1: Assess and iteratively improve crop-livestock combinations from Phase I Activity 1.1.2: Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, and forages
Output 1.2: Demand-driven, labor-saving and gender-sensitive research products to reduce drudgery while increasing labor efficiency in the production cycle piloted for relevant typologies in target areas [and scaled in Outcomes 4 and 5]	Activity 1.2.1: Support local partners through training on appropriate drudgery-reducing technology delivery Activity 1.2.2: Co-adapt existing mechanization options with target communities
Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies	
Output 2.1: Demand-driven research products for enhancing soil, land and water resources management to reduce household/community vulnerability and land degradation piloted in priority agro-ecologies [and scaled in Outcome 5]	Activity 2.1.1: Characterize current practices in ESA through identifying formal and informal arrangements for access to and use of water and land resources Activity 2.1.2: Identify opportunities for using supplementary irrigation in different framing systems of the ESA target country agro-ecologies
Output 2.2: Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5]	Activity 2.2.1: Set up demonstration and learning sites in target ESA communities
Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households)	
Output 3.1: Output 3.1: Demand-driven research products to reduce postharvest losses and improve food quality and safety piloted in target areas [and scaled in Outcome 5]	Activity 3.1.1: Conduct packaging and delivery of postharvest technologies through community and development partnerships with iterative review, refining, and follow-up
Output 3.2: Nutritional quality improved through increased accessibility and use of nutrient-dense crops and livestock products.	Activity 3.2.1: Promote and deploy nutrient-rich crop varieties and livestock feed resources in target communities
Output 3.3: Capacity of farming communities and partners to consume nutrient-dense crops and livestock products enhanced	Activity 3.3.1: Conduct packaging and delivery of crop and fodder varieties and associated management practices through community and development partnerships with iterative reviewing and refining

Outcome 4: **:** Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved	
Output 4.1: Access to profitable markets for smallholder farming communities and priority value chains facilitated	Activity 4.1.1: Conduct comprehensive value-chain analysis with a specific focus on SI technologies Activity 4.1.2: Conduct a value chain stakeholder analysis (stakeholder mapping) Activity 4.1.3: Develop a value chain enhancement strategy (including collective action approaches, contractual arrangements, and standardization Activity 4.1.4: Identify and evaluate existing mechanisms that inform farmers about dynamic market needs Activity 4.1.5: Conduct an analysis of the existing baseline survey data and supplement them with qualitative surveys from target regions
Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized	
Output 5.1: Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies	Activity 5.1.1: Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations Activity 5.1.2: Use farm trial data to apply crop simulation models (APSIM) and assess performance over space and time, including assessment of climate-smart technologies to establish the potential for adaptation and mitigation Activity 5.1.3: Establish adaptive field experiments with mineral and animal-derived organic manure Activity 5.1.4: Demonstrate the use and impact of crop residues, forages, and other organic resources as animal feed and nutrient resources Activity 5.1.5: Use crop-livestock models for trade-off analysis Activity 5.1.6: Disseminate best-fit integrated crop-livestock technologies to reach and have effect on small-scale farmers in a landscape context
Output 5.2: Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products established	Activity 5.2.1: Map and assess relevant stakeholders to establish dialogue for the exploration of mutual synergies for scaling delivery of validated technologies Activity 5.2.2: Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways
Output 5.3: Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners	Activity 5.3.1: Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies
Output 5.4: A technology adoption, monitoring, evaluation, and learning framework for use by the project team and	Activity 5.4.1: Monitor and modify the progress of technology adoption process towards scaling

scaling partners released [led by IFPRI and used by project partners]	Activity 5.4.2: Develop knowledge sharing centers and learning alliances within existent local and regional institutions

Workplan overview

Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enahnced under climate variability	**Partner**
Output 1.1: Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies and scaled in Outcomes 4 and 5	
Activity 1.1.1: Assess and iteratively improve crop-livestock combinations from Phase I	
Sub-activity 1.1.1.1 Validate drought tolerant maize (DT) hybrids under on-farm conditions in Kongwa and Kiteto for future integration in crop-livestock production systems	CIMMYT
Sub-activity 1.1.1.1 Investigations on the medium to long term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient and water management) on crop productivity on multi-locational fields sites and baby trials	MSU
Sub-activity 1.1.1.1: Determining the productivity and resilience benefits of Gliricidia-based cropping systems	ICRAF
Sub-activity 1.1.1.2 Determining the productivity of groundnut as a function of generation x variety x density interactions in two contrasting agroecologies	MSU
Sub-activity 1.1.1.1 To assess the effect of home-made feed rations based on *Gliricidia sepium* and vegetable waste on productivity of selected strains of chickens	ILRI
Sub-activity 1.1.1.3 Exploring the dynamics of indigenous goat performance under intensive crop-livestock management integration in Malawi	MSU
Sub-activity CIAT-1 Assess the yield, economic and BNF (biological nitrogen fixation) benefits of innovative approaches addressing the pigeon pea and common bean productivity within maize-based cropping system and variable weathe	CIAT
Sub-activity CIAT-2 Test climate-smart farming practices (tied ridges, weather-informed varieties, cover crops integration [cowpea, lablab, medium duration pigeon pea]) for increasing productivity of maize-legume system under variable weather conditions	CIAT

Activity 1.1.2: Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, and forages	
Sub-activity 1.2.1.1 Conduct integrated community breeding and management studies for poultry	UDOM
Sub-activity ILRI Dairy-1 To test the effect of feeding Napier grass and Maize stover supplemented with bean haulms at different levels on milk yield under smallholder farmer conditions	ILRI
Sub-activity 1.1.2.1 WorldVeg Assessment of the benefits of technologies on performance of different vegetable varieties	WorldVeg
Sub-activity 1.1.2.2 Worldveg Assess the efficacy of a nethouse and biopesticides in controlling Bemisia tabaci and Tuta absoluta on solanaceous vegetables	WorldVeg
Sub-activity SUA-1 Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, and forages	SUA-soils
Sub-activity SUA-2 Assessing the integrative effect of in-situ rainwater harvesting and fertilizer micro-dosing on crop yield, water and nutrient use efficiency in Kongwa District.	SUA-soils
Output 1.2: Demand-driven, labor-saving and gender-sensitive research products to reduce drudgery while increasing labor efficiency in the production cycle piloted for relevant typologies in target areas [and scaled in Outcomes 4 and 5]	
Activity 1.2.1: Support local partners through training on appropriate drudgery-reducing technology delivery	
Sub-activity 1.2.1.2 Validation of residual tied ridging as a labour-saving technology in semi-arid Areas of Central Tanzania	TARI-Hombolo
Activity 1.2.2: Co-adapt existing mechanization options with target communities	
Sub-activity 1.2.2.1 Use of tractor mounted ripper tillage implement for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto, Manyara Region	TARI-Hombolo
Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies.	
Output 2.1: Demand-driven research products for enhancing soil, land and water resources management to reduce household/community vulnerability and land degradation piloted in priority agro-ecologies [and scaled in Outcome 5]	

Activity 2.1.1: Characterize current practices in ESA through identifying formal and informal arrangements for access to and use of water and land resources.	
Sub-actiity SUA-3 Evaluation of land rehabilitation benefits of shelterbelts and contours (Soil and plant sampling from ICRAF and TARI Hombolo sites).	SUA-soils
Sub-activity 2.1.1.2 Land rehabilitation through the integration of fodder trees and grass forage species in dryland farming.	ICRAF
Activity 2.1.2: Identify oppportunities for using suplementary irrigation in different farming systems of the ESA target country agro-ecologies.	
Output 2.2: Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5].	
Activity 2.2.1 Set up demonstration and learning sites in target ESA communities.	
Sub-activity 2.2.1.1. Demonstrate technologies on soil and water conservation for enhancing resilient to climate change in semi-arid agro-ecologies of Central Tanzania	TARI-Hombolo
Sub-activity 2.2.1.1 Investigations on nutrient and water management for climate resilience along a climate gradient in southern Malawi	MSU
Sub-actviity 2.2.1.2 Rainfall-responsive nitrogen fertilization strategies: in search of increased nitrogen use efficiency by smallholder farmers under rainfed conditions	MSU
Sub-activity 2.2.1.3 Assessing the effect of residue quantity and quality, and water conservation on maize productivity and nitrogen dynamics on smallholder farms in Malawi	MSU
Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households).	
Output 3.1: Demand-driven research products to reduce post-harvest losses and improve food quality and safety piloted in target areas [and scaled in outcome 5)	

Activity 3.1.1 Conduct packaging and delivery of post-harvest technologies through cimmunity and development partnerships with iterative review, refining and follow-up.	
Output 3.2: Nutritional quality improved through increased accessibility and use of nutrient-dense crops and livestock products.	
Activity 3.2.1: Promote and deploy nutrient-rich crop varieties and livestock feed resources in target communities.	
Sub-activity 3.1.2.1 Assess the impact of nutritional messaging on farmers nutritional knowledge, attitude and practices and household nutrition status	Worldveg
Sub-activity 3.2.1.1 Promote farmer production of nutrient dense (Zn, Fe) SER83 and NUA45 bean varieties produced by CIAT during 2018.	LUANAR
Sub-activity 3.2.1.1. Elucidate pathways to sustainable adoption of nutrient diets and aflatoxin mitigation practices in rural communities of Central Tanzania	SUA-nutrition
Output 3.3: Capacity of farming communities and partners to consume nutrient-dense crops and livestock products enhanced.	
Activity 3.3.1: Conduct packaging and delivery of crop and fodder varieties and associated management practices through community and development partnerships with iterative reviewing and refining.	
Sub-activity 3.3.1.1 Determining the quality and safety of locally produced legume grain-derived complementary foods and adoption in Dedza District.	LUANAR
Outcome 4: Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved.	
Output 4.1: Access to profitable markets for smallholder farming communities and priority value chains facilitated.	
Activity 4.1.1: Conduct comprehensive value-chain analysis with a specific focus on SI technologies.	
Sub-actvity 4.1.1.1 Conduct value chain analysis (VCA) for (nutrient dense) maize seed in Kongwa and Kiteto	CIMMYT
Sub-activity 4.1.1.1 Value chain analysis of groundnut seed and design of operation enhancement strategies for semi-arid ecologies of central Tanzania	ICRISAT

Activity 4.1.2: Conduct a value chain stakeholder analysis (stakeholder mapping).	
Activity 4.1.3: Develop a value chain enhancement strategy (including collective action approaches, contractual arrangements, and standardization.	
Activity 4.1.4: Indetify and evaluate existing mechanisms that inform farmers about dynamic marjet needs.	
Activity 4.1.5: Conduct an analysis of the existing baseline survey data and supplement them with auqlaitative surveys from target regions.	
Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized.	
Output 5.1: Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies.	
Activity 5.1.1: Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations.	
Sub-activity 5.1.1.1 Explore the productivity domains of selected legumes and cereals to elucidate their best fitting cropping system at community/landscape level and their dissemination	ICRISAT
Sub-activity 5.1.2.1 Crop simulation modelling with APSIM to explore medium to long term SOC, and resource use efficiencies in intercropping systems	ICRISAT
Sub-activity 5.1.2.1 Apply APSIM crop simulation model to assess changes in resource use efficiencies, productivity and profitability of the different cropping systems in Kongwa, Kiteto and Iringa in Tanzania	WUR
Activity 5.1.3: Establish adaptive field experiments with mineral and animal-derived organic manure.	
Activity 5.1.4: Demonstrate the use and impact of crop residues, forages, and other organic resources as animal feed and nutrient resources.	

Sub-activity 5.1.4.1 Engage development partners to determine which technology they are interested in / or currently engaged in and would like to take to scale (including financially supporting the process) ILRI role will be to develop their capacity in the ability to understand, demonstrate and scale the technology and back-stop their scaling if necessary, and address research needs as they are identified in the process.	
Activity 5.1.5: Use-crop-livestock models for trade-off analysis.	
Activity 5.1.6: Disseminate best-fit integrated crop-livestock technologies to reach and have effect on small-scale farmers in a landscape context.	
Sub-activity WUR-1 Small-scale piloting of FarmMATCH – a framework for typology-based targeting and scaling of agricultural innovations. (Matching Agricultural Technologies to Farms and their Context)	WUR
Output 5.2: Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products established.	
Activity 5.2.1: Map and assess relevant stakeholders to establish dialogue for the exploration of mutual synergies for scaling delivery of validated technologies.	
Activity 5.2.2: Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways.	
Sub-activity 5.2.2.1 Engage with seed companies to accelerate QPM seed scaling	CIMMYT
Sub-activity 5.2.2.2 Engage able and willing partners to develop a strategy and implementation framework for scaling up intensification technologies in semi-arid ecologies of central Tanzania	ICRISAT
Output 5.3: Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners.	
Activity 5.3.1: Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies.	
Sub-activity 5.3.1.1 Role of gender from farm-to-fork and the market, of grain legumes and dryland cereals in Kiteto and Kongwa	ICRISAT
Farmer/Extension messaging (forage production and use, crop residue processing and use and feed rations) using MWANGA	ILRI

	Output 5.4: A technology adoption, mionitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners].				
		Activity 5.4.1: Monitor and modify the progress of technology adoption process towards scaling.			
		Activity 5.4.2: Develop knowledge sharing centers and learning alliances with existent local and regional institutions.			

Detailed workplans

Outcome 1

Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enahnced under climate variability.				
Output: 1.1	Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies and scaled in Outcomes 4 and 5			
Activity: 1.1.1	Activity 1.1.1: Assess and iteratively improve crop-livestock combinations from Phase I			
Sub-activity: 1.1.1.1-CIMMYT	**Sub-activity 1.1.1.1: Validate drought tolerant maize (DT) hybrids under on-farm conditions in Kongwa and Kiteto for future integration in crop-livestock production systems**			
Research team				
Name	Institution	Role		
Bright Jumbo	CIMMYT	PI (principal investigator)		
Elirehema Swai	TARI-Hombolo	Backstop R4D activities		
Anicet Sambala	IITA	To provide support in monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system		
Francis Muthoni	IITA	To use yield and weather data for modeling application to generate maize variety adaptation maps		
Student(s)				
Name	Institute	Degree	Start	End
Location(s)	The following sites/villages will be used: Ismani, Igula, Kihorogota, Ndoela, Mlali, TARI-Hombolo, Sagara			
Start	October 2017			
End	September 2019			
1. Justification: See Protocol # I (Appendix 1)				
2. Objectives: See Protocol # 1 (Appendix 1)				
3. Research questions: See Protocol # I (Appendix 1)				
4. Experiment design, implementation and data analysis: See Protocol (Appendix 1)				
5. Data to be collected and uploaded on dataverse				
6. SI Domain and indicators			Responsible institute	
Productivity:			CIMMYT	

Yield data measured in kg/ha, biomass measured in Kg/ha; refer to appendix I, protocol 1	
Environmental: Plant biodiversity (# of varieties). Number of maize varieties grown in neighboring fields, Status on levels of major disease and pest (appendix I, protocol 1)	CIMMYT
Economic: Profitability/Gross margins (USD) calculated from the information on production costs and income based on yield data (appendix 1, protocol 1)	CIMMYT
Social: Gender equity (technology and variety performance ratings based on gender during field days. Information will be collected during field days on participatory variety selection (Appendix 1, protocol 1)	CIMMYT
Human Condition: Knowledge on best hybrids by community/capacity to experiment. Ratings of varieties by farmers (# of farmers by gender desegregation choosing a particular variety). Information can be collected during field days (appendix 1, protocol 1).	CIMMYT

7. Deliverables:	Means of verification	End date
1. High performing DT hybrids confirmed	Project progress reports, M&E reports	20 Sep. 2019
2. Profitable hybrids identified	Gross margin analysis results	20 Sep. 2019
3. Community participation enhanced & knowledge about best DT hybrids increased	Field day reports	Aug. 2019
4. Hybrid with high biomass identified	Project reports	20 Sep. 2019
5. Status on major disease/pest known	Project reports	30 Aug. 2019

8. How will scaling be achieved?
Engagement of seed companies & agro-dealers through variety release, commercialization and delivery of certified seed to local market outlets accessible by local farming communities in Kongwa and Kiteto. Refer to sub-activity 5.2.1.1
9. How are the activities in this protocol linked to those of others?
To realize hybrid yield potential, good agronomic combined with good soil and water conservation practices are critical. Choice agronomic practices for the new varieties are validated with the S&WC (TARI-Hombolo) and ISFM protocols (SUA). Results from validated agronomic studies and soil and water conservation studies will be packaged together with the output from this study and available for scaling.

3. Sub-activity 1.1.1.1-MSU	**Investigations on the medium to long term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient and water management) on crop productivity on multi-locational fields sites and baby trials**	
Research team		
Name	Institution	Role

Regis Chikowo, Sieg Snapp	MSU	PIs, research conceptualization, design, implementation		
ESA Economist	IITA	Backstopping on economic evaluation		
Gundula Fischer	IITA	Technical backstopping on gender and labor analyses		
Anicet Sambala	IITA	M&E		
Lieven Claessens	IITA	Ex-ante impact assessment with Trade-off Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD) for regional relevance of Africa RISING technologies		
Student(s)				
Name	Institute	Degree	Start	End
Chiwimbo Gwenambira	MSU	PhD Agroecology	2016	2019

Location(s)	Linthipe, Golomoti, Kandeu, Nsipe, Mtubwi, Nsanama, Nyambi, Ntiya Extension Planning Areas (EPAs)
Start	Some sites started 2013; some November 2016
End	November 2019 (Machinga/Mangochi); September 2021 (Dedza/Ntcheu)

1. Justification: See Protocol A	
2. Objectives: See Protocol A	
3. Research questions: See Protocol A	
4. Experiment design, implementation and data analysis: See Protocol A	
5. Data to be collected and uploaded on dataverse	
6. SI Domain and indicators	Responsible institution
Productivity: Maize, soyabean, groundnut, pigeonpea grain productivity (kg/ha/season); maize, soyabean, groundnut, pigeonpea biomass productivity (kg/ha/season); Variability of production (CV); yield gap per crop (kg/ha/season); nitrogen use efficiency (kg grain/kg N applied)	MSU
Environmental: Water availability (soil moisture by treatment); total soil carbon (%SOC); biological N2-fixation estimates (kg/ha N fixed per season); Rating of erosion	MSU
Economic: Profitability of different technologies; Net income ($/crop/ha/season); Gross margin ($/ha/season); Benefit-Cost Ratio; Input use intensity (input kg/ ha); Labor requirement - farmer rating of labor	MSU and IITA
Social: Rating of technologies by gender	MSU and IITA
Human Condition: Nutrition- protein production (g/ha); Food security - food production (calories/ha/year)	MSU

7. Deliverables	Means of verification	End date

1. SI Field trials established for each site	List of field trials, host farmer names available	Jan. 2019
2. Baby trials established by at least 3000 farmers experimenting with SI technologies	Farmer lists and SI technologies being implemented in baby trials	Jan. 2019
3. Benefits of SI technologies evaluated across sites	Productivity data files available	Sept. 2019
4. At least one field day per site conducted	Field day reports	Sept. 2019
5. At least 3 farmer exchange visits conducted	Farmer exchange visits reports	Aug. 2019

8. How will scaling be achieved?

Malawi extension system (District Agricultural Extension Coordinating Committees – DAECC) that has oversite on technology dissemination at the district level will help disseminate technologies in Extension Planning Areas (EPAs) that are not physically reached by Africa RISING project. The DAECC constitutes a network that includes the district-level government extension system and all NGOs operating in the district. This body harmonizes agricultural technologies dissemination approaches and improves the efficiency of use/allocation of financial resources by different actors in the different EPAs.
Hold joint farmer field days in partnership with DAECC

9. How are the activities in this protocol linked to those of others?

Choice of crop varieties has been harmonized based on experiences and technical advice from ICRISAT. For example, groundnut varieties used in this sub-activity and in LUANAR sub-activity B are based on guidance from ICRISAT breeders. Increased productivity of grain legumes based on this sub-activity is directly linked to nutrition studies, sub-activity 3.3.1.1

Sub-activity 1.1.1.1-ICRAF	**Sub-activity 1.1.1.1: Determining the productivity and resilience benefits of Gliricidia-based cropping systems**	
Research team		
Name	Institution	Role
A. Kimaro	ICRAF	PI, research design and oversight of project activities
E. Temu	ICRAF	Contribute to socio-economic, gender and labor studies
Kotu Bekele	IITA	Technical backstopping on economic analyses (Section 3-protocol)
Gundula Fischer	IITA	Technical backstopping on gender and labor analyses (Section 3-protocol)
F. Muthoni	IITA	Technical support on GIS-based soil erosion

		mapping (Section 3-protocol)
Anicet Sambala	IITA	Support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system

Students				
Name	Institute	Degree	Start	End
Lean Renwick	UC Davis	PhD	2019	2019
J. Hafner	Humboldt	PhD	2018	2019

Locations	Manyusi, Mlali and Molet villages in Kongwa District
Start date	Oct. 2017
End date	Sept. 2021

1. Justification: See Protocol

2. Objectives: See Protocol

3. Research questions: See Protocol

4. Experiment design, implementation and data analysis: See Protocol

5. Data to be collected and uploaded on dataverse

6. SI Domain and indicators	Responsible institute
Productivity: Maize grain and stover yield (t/ha); wood and foliage biomass (t/ha)	ICRAF
Environmental: Soil carbon (g/kg-soil); Soil moisture (%), Rainwater use efficiency (kg/mm/yr); Nutrient uptake (kg/ha); Nutrient use efficiency (kg/uptake); weather data; GPS points	ICRAF and SUA (Shitindi)
Economic: Gross margin in USD/ha; Benefit-Cost Ratio-BCR;	ICRAF and IITA (Kotu)
Social: Food availability (number of food sufficiency month per household/year)	ICRAF
Human Condition: Perception of benefits of the technology by gender	ICRAF and IITA (Gundula)

7. Deliverables	Means of verification	End date
At least 50 farmers are mobilized and engaged in validating *G. sepium* intercropping in baby trials	Progress report	Apr. 2019
Co-organized farmer field day and Nane-nane exhibition	Activity & progress reports	May and Aug. 2019
Yield (crops and biomass) and resilience benefits of *G. sepium-based cropping systems* intercropping determined	Progress report	Aug. 2019
Economic benefits of *G. sepium* intercropping evaluated	Progress report	Aug. 2019
Gender analysis of at least 50 farmers	Progress report	Aug. 2019

8. How will scaling be achieved? ICRAF will work with Dorcas group at Mlali, TANAPA (Kilosa), Extension officers and DAICOs to deliver at least at least 10,000 seedlings and agroforestry education to non-AR sites (e.g., Ngumbi and Kitete Msindazi villages)

9. How are the activities in this protocol linked to those of others? Test crop (Maize variety and pigeonpea) used in this trial are promising variety selected by ICRISAT and CIMMYT. *G. sepium* fodder is use in pen goat feeding trials in Malawi and similar work can be adopted for Kongwa for draught animals, which needs supplementary feeding for high productivity. Also used in poultry feeds in the KK/Babati poultry feed experiments

Sub-activity 1.1.1.2-MSU	**1.1.1.2 Determining the productivity of groundnut as a function of generation x variety x density interactions in two contrasting agroecologies**

Research team:

Name	Institution	Role
Wezi Mhango	LUANAR	PI, research conceptualization, design, implementation
Regis Chikowo	MSU	Backstop biological N2-fixation methods
Anicet Sambala	IITA	M&E

Students

Name	Institute	Degree	Start	End
Jester Kalumba	LUANAR	MSC	2017	2019

Location:	Linthipe, Mtubwi, Extension Planning Areas (EPAs)
Start date:	Nov. 2017
End date:	Nov. 2019

Justification: See Protocol B

Objectives: See protocol B

Experiment design, implementation and data analysis: See Protocol B

5. Data to be collected and uploaded on dataverse	
SI Domain and indicators	Responsible institution
Productivity: Groundnut grain productivity (kg/ha/season); groundnut biomass productivity (kg/ha/season)	LUANAR
Environmental: Biological N2-fixation estimates (kg/ha N per season)	LUANAR
Economic: Profitability of different technologies (Gross margin) in $/ha, Benefit-Cost Ratio	LUANAR
Social: Rating of technologies by gender (see survey S1)	LUANAR and MSU
Human Condition: Nutrition- protein production (g/ha), aflatoxins (micrograms/kg)	LUANAR

6. Deliverables	Means of verification	End date
At least one field trial established in Linthipe and Ntubwi Site description details (soils, seasonal rainfall)	Trial establishment protocol and report	Feb. 2019
Density x variety x seed generation assessed	Technical report	Sep. 2019
At least 5,000 farmers in Dedza and Machinga adopting double-row cropping of groundnut	Internal reports from Dedza and Machinga DADO offices	Sep. 2019
MSc thesis	Thesis submitted	Sep. 2019

7. How will scaling be achieved?
LUANAR participates in the Malawi agricultural technology assessment committee. Information from these trials will be discussed at this level for uptake by different stakeholders with interests in groundnut production and associated value chains

8. How are the activities in this protocol linked to those of others?
Groundnut varieties used originate from ICRISAT research and are used for activities in Protocol A.

Activity 1.1.1	Assess and iteratively improve crop-livestock combinations from Phase I
Sub-activity: ILRI Poultry 1	To assess the effect of home-made feed rations based on *Gliricidia sepium* and vegetable waste on productivity of selected strains of chickens

Systems research team:		
Name	Institution	Role
Ben Lukuyu	ILRI	PI - ILRI
Leonard Marwa	TALIRI – West Kilimanjaro	Technical backstopping on poultry feeding trials

Chrispinus Rubanza	UDOM	PI – UDOM; sourcing experimental chicks		
Mr. Mbesere	Extension staff – Babati district	Farmer mobilisation, training and backstop livestock feeding trials		
-	Extension staff – Kongwa, Kiteto districts	Farmer mobilisation, training and backstop livestock feeding trials		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	Two villages (Babati district) and two villages (Kongwa, Kiteto districts)			
Start date	2018			
End date	2020			
Justification: See Protocol				
Objectives: See protocol				
Research questions: See Protocol				
Experiment design, implementation and data analysis: See Protocol				
Data (with metrics) to be collected and uploaded on Dataverse				
			Responsible institution	
Productivity: ***Animal Productivity*** - Animal products (amount /animal /year) - Animal by-products (amount /animal /year) - Rating of animal productivity			ILRI, UDOM	
Economic: ***Profitability*** - Profitability (gross margin per flock of 100 birds expressed in $/batch			ILRI, UDOM	
Social: ***Gender equity*** - Rating of technologies by gender			ILRI, UDOM	
Human Condition: ***Food security and nutrition*** - Protein production (g/bird)				

Deliverables:	Means of verification	End date
Ethical approval	Ethical approval certificate (ILRI)	February 2019
Experimental diets formulated and sampled	An evaluation report (ILRI)	April 2019
Feeding experiment set up	Quarterly progress report (ILRI)	May 2019
Nutritive value of diets evaluated	Nutritive value data set (ILRI)	July 2019
Experimental diets evaluated by farmers	Farmer evaluation report (ILRI/UDOM)	June 2019
Feeding trials completed	Productivity data sets (ILRI/UDOM)	August 2019
Complete data analysis	Technical report to IITA(ILRI/UDOM)	September 2019

How will scaling be achieved?
Partnership with COSITA FIDE and World Vision estimated to reach about 1000 farmers through the MWANGA platform
How are the activities in this protocol linked to those of others?
This activity is linked to the vegetable research by World Vegetable Centre and the manure management research by ILRI

Sub-activity 1.1.1.3-MSU	**Exploring the dynamics of indigenous goat performance under intensive crop-livestock management integration in Malawi**	
Research team:		
Name	Institution	Role
Fanny Chigwa	LUANAR	PI, research conceptualization, design, implementation
Regis Chikowo	MSU	Logistical support
Gundula Fischer	IITA	Gender analysis
Anicet Sambala	IITA	M&E

Students:				
Name	Institute	Degree	Start	End
Dyton Maselema	LUANAR	MSc Animal Science	2018	2020

Location(s):	Linthipe, Mtubwi, Extension Planning Areas (EPAs)	
Start date	November 2017	
End date	November 2019	
Justification: See Protocol C		
Objectives: See protocol C		
Experiment design, implementation and data analysis: See Protocol C		
Data (with metrics) to be collected and uploaded on dataverse:		
SI Domain	Responsible institution	
Productivity: Daily growth rate of goats (g/day), goat meat production (amt./animal/yr); Rating of animal productivity	LUANAR	
Environmental: Animal by-product (manure quality, %N content)	LUANAR	
Economic: Farmer rating of labor (labor input of pen feeding and group herding compared to each farmer herding own goats)	LUANAR	
Social: Rating of technologies by gender	LUANAR and IITA	
Human Condition: protein production (extra goat protein/feeding duration)	LUANAR	
Deliverables:	Means of verification	End date
Goat feeding trials established	Protocol available	Mar. 2019
Weight gain assessments done fortnightly	Technical report	Sep. 2019
Breeding goats available to communities	Breeding goats available in Linthipe and Ntubwi EPAs	Apr. 2019
MSc thesis	Draft Chapters completed	Sep. 2019
How will scaling be achieved? Malawi extension system at district level (the District Agricultural Extension Coordinating Committees – DAECC) is a prime vehicle for disseminating improved goat rearing technologies to other EPAs and districts.		
How are the activities in this protocol linked to those of others?		

Crop residues produced from other sub-activities are potential goat intensification feed resources. CIAT is investigating the potential of common bean varieties to provide residues appropriate as goat feed

Sub-activity – CIAT 1	Assess the yield, economic and BNF (biological nitrogen fixation) benefits of innovative approaches addressing the pigeon pea and common bean productivity within maize-based cropping system and variable weather			
Systems research team:				
Name	**Institution**	**Role**		
J. Kihara	CIAT	PI		
B. Lukuyu	ILRI	Determination of residue quality and impact (feeding days)		
B. Lukuyu/ L. Marwa	ILRI/TALIRI	Value addition of maize grain through feeding of poultry rather than selling as grain, assessing the quality of stripping and toppings as livestock feed (role may be delayed to 2020 season if partners don't have money for it)		
Jonas/ Rose	MoA	Organize field days and supervise field operations by farmers		
Anicet Sambala	ESA M&E Officer & Data Manager	To support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	Seloto, Sabilo, Orngadida villages of Babati District			
Start date	Jan. 2017			
End date	Nov. 2020			
Justification: See Protocol on Increasing productivity of pigeon pea within maize pigeon pea systems in 3 eco-zones of Babati, Tanzania				
Objectives: See protocol				
Research questions: See Protocol				
Experiment design, implementation and data analysis: See Protocol				
Data (with metrics) to be collected and uploaded on dataverse				
			Responsible institution	
Productivity: Crop productivity and crop biomass productivity (Residue production at plot level during stripping and topping and final harvest). 1. Maize residue production at plot level during stripping and topping (kg/ha/season) 2. Maize grain yield (kg/ha/season). 3. Maize stover yield at harvest (kg/ha/season) 4. Pigeon pea grain yield (kg/ha/year)			CIAT/MoA/ILRI	

Environmental: 1. Biological nitrogen fixation at plot level (kg N ha^{-1} $season^{-1}$) 2. Fuel availability (fuel biomass i.e., wood produced at plot level (kg ha^{-1} $season^{-1}$) 3. Soil chemical quality (pH and nutrient levels) 4. Soil physical properties (soil moisture) at plot level (m^3m^{-3}) 5. Infiltration rates at field level ($cmsec^{-1}$) 6. Light interception at plot level	CIAT/MoA
Economic: Profitability: gross margin at plot level and, labour requirement *1.* Gross margin at plot level ($/crop/ha/season) *2.* Labour requirement (farmer rating of labour).	CIAT/ ILRI/TALIRI
Social: Gender equity (Rating of technologies by gender) • Rating of technologies by gender (% change)	CIAT/MoA
Human Condition: Food security *1.* Food production at plot level (Calories/ha/year) *2.* Using available literature derive protein output (g/ha)	CIAT

Deliverables:	Means of verification	End date
6 on-farm trials, 2 in each of 3 eco-zones, successfully Implemented	Research reports	Oct. 2019
3 new technologies introduced and tested	Research reports	Oct. 2019
BNF of pigeon pea quantified	Research reports	Nov. 2019
150 farmers trained (in field days)	Field day reports	Oct. 2019

Sub-activity – CIAT 2	**Test climate-smart farming practices (tied ridges, weather-informed varieties, cover crops integration [cowpea, lablab, medium duration pigeon pea]) for increasing productivity of maize-legume system under variable weather conditions**	
Systems research team:		
Name	Institution	Role
J. Kihara	CIAT	PI
Jonas/Rose	MoA	Supervise field operations by farmers
Anicet Sambala	ESA M&E Officer & Data Manager	To support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FfF system

Student(s):				
Name	Institute	Degree	Start	End
Location(s):	Sabilo and Gallapo			

Start date	Dec 2016
End date	Nov 2020

Justification: See Protocol titled "Test climate-smart farming practices for increasing productivity of maize-legume system under variable weather conditions"

Objectives: See protocol

Research questions: See Protocol

Experiment design, implementation and data analysis: See Protocol

Data (with metrics) to be collected and uploaded on dataverse

	Responsible institution
Productivity: Crop productivity and crop biomass productivity (Yield production, residue production at plot level) 1. Maize grain yield at plot level (kg/ha/season). 2. Maize stover yield at harvest at plot level (kg/ha/season) 3. Pigeon pea grain yield at plot level (kg/ha/year)	CIAT/MoA
Environmental: Soil water conservation and Soil nutrient levels (Soil physical properties (soil moisture) at plot level. Daily rainfall and temperature measurements at community/landscape level. Chlorophyll meter readings at plot level.) 1. Soil moisture at plot level (m^3m^{-3}) 2. Daily rainfall at community/landscape level (mm) 3. Daily temperature measurements at community/landscape level (^oC)	CIAT/MoA
Economic: Profitability and labor requirements (Profitability (gross margin at plot level and labour requirement) *1.* Profitability- gross margin at plot level ($/crop/ha/season) *2.* Labour requirement (farmer rating of labour)	CIAT
Social: Gender equity • Rating of technologies by gender	CIAT/MoA
Human Condition: Food security and nutrition (Food production at plot level and using available literature derive protein output) *1.* Food production at plot level (Calories/ha/year) *2.* Using available literature derive protein output (g/ha)	CIAT

Deliverables:	Means of verification	End date
4 on-farm trials, 2 in each of 2 eco-zones, successfully Implemented	Research reports	Oct. 2019
2 new technologies being tested	Research reports	Oct. 2019
30 farmers trained	Training report	Aug. 2019
Soil moisture and SPAD data uploaded	Uploads	Oct. 2019

How will scaling be achieved?

Partnership with Meru Agro Seed Company to deliver Improved maize seeds and provide advice to farmers, with World Vision and with Cosita to potentially utilize Mwanga ICT platform in communication of agronomic information. Besides, farmers already enlisted in Mwanga will receive monthly agronomic messages.
How are the activities in this protocol linked to those of others?
ILRI and TARILI utilize residues from toppings and strippings for livestock. Double-up legumes also contained in protocols for Kongwa-Kiteto and Malawi. We are utilizing Mwanga ICT, a tool developed within Africa RISING.
Testing of climate smart technology in Babati complementing similar works (tied ridges) at Kongwa and kiteto

Output: 1.2	Demand-driven, labor-saving and gender-sensitive research products to reduce drudgery while increasing labor efficiency in the production cycle piloted for relevant typologies in target areas [and scaled in Outcomes 4 and 5]			
Activity: 1.1.2	Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, and forages			
Sub-activity: 1.1.2.1: UDOM	**Conduct integrated community breeding and management studies for poultry**			
Research team:				
Name	Institution	Role		
Chrispinus D. Rubanza	UDOM	PI and oversee chicken breeding		
Edward A. Moto	UDOM	Lead the chicken molecular studies		
Faustine M. Kashumba	UDOM	Lead the Socio-economic/Community livelihood sub-component		
	DAICOs offices	Backstop R4D activities		
Anicet Sambala	IITA	To support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system		
Students:				
Name	Institute	Degree	Start	End
Locations: Mlali- Kongwa; Mwanya-Kiteto; Galapo, Dareda and Matufa, Babati.				
Start date	Dec. 2014			
End date	Dec. 2021			
Justification: See Protocol				
Objectives: See protocol 1. To test and validate performance (hatchability, chick survival, growth rate, body weight and other qualitative and quantitative traits) of chicken crossbreds compared to their local ecotypes/ sub-ecotypes, commercial dual purpose and pure meat strains				

2. To test and validate the potential of community chicken breeding model as a source of chicks/ chicken growers
3. To determine egg physical and chemical parameters of chicken crossbreds
4. To assess the socio-economic contribution of chicken crossbreds

To Assess the impact of introducing chicken crossbreds on livelihoods in the study sites

Research questions: See Protocol

1) Do local chicken- egg/meat type strain' crosses exhibit higher growth rates than local chicken populations and pure lines?
2) Are local chicken- egg/ meat type strain' crosses have relatively high disease resistance compared to pure egg/ meat strains?
3) Do local chicken- egg/meat type strain' crosses lay a higher number of eggs and produce more meat than local chicken populations?
4) Do local chicken- egg/meat type strains' crosses generate much more income than local chicken populations?
5) Does keeping of local chicken- egg/ meat type strains' crosses lead to improved livelihood compared to local chicken farming?
6) Are there genetic differences between local, pure and crossbreds chicken strains?
7) Are there any correlations between phenotypic/physical traits and economic traits? (Growth rate, egg production, meat)?

Experiment design, implementation and data analysis: See Protocol

Data (with metrics) to be collected and uploaded on dataverse

SI-domain	**Responsible Institution**
Productivity: Livestock Productivity 1) Number of eggs per chicken flock per year 2) Per cent egg hatchability (%) per chicken flock per year 3) Growth rate/ rate of gain (g/d/year) 4) Body weight (kg/ chicken; kg/ strain); 5) Egg weight (g/egg) 6) Egg quality (albumen weight, yolk weight, yolk colour, eggshell weight, egg thickness) 7) Meat weight/chicken/ strain, meat colour, meat taste, meat aroma, meat juiciness 8) Survival rate- number of surviving individuals per birth	UDOM
Environmental: Pesticide use 1) Active ingredient applied per bird 2) Diseases resistance, incidence and severity. 3) Survival rate- number of surviving individual chicks/ chickens per birth.	UDOM
Economic: Profitability 1) Cost-benefit analysis of the household chicken projects (output sold X price – input costs). 2) Total poultry profit per households. 3) Diversification index for all marketable poultry enterprises. 4) Diversification index for all poultry income-based household activities.	UDOM

5) Number of output/unit-input of poultry-based enterprises in each household under the Project compared to non-project chicken keeping households. 6) Market participation in terms of % of poultry production sold at household level. 7) % of total income generated from chicken- based activities.	
Social: Gender equity 1) Improved household income through more involvement of women in poultry keeping compared to men. 2) % labour for power vs. control activities at household-level 3) Gender roles across sex in poultry keeping. 4) Gender roles in decision making about poultry production and marketing at household level. 5) Level of social cohesion in terms of household participation in community chicken management activities as influenced by gender. 6) Number of Active farmer groups in terms of Improved social networks through farmers groups that improve women and youth participation in poultry projects 7) Contribution of gender on community chicken management. 8) Variability and distribution of productivity, income and assets at household level across men and women.	UDOM
Human Condition: Nutrition and Food security 1) Protein produced (kg/farm) and meat-protein intake and egg-protein intake. 2) Food consumption score (7-days recall of frequency of food types). 3) Frequency of consumption of egg-protein- and meat- protein-based diets/ recipes. 4) Farmers' perceptions of the introduced chicken strains/ breeds. 5) Adoption rate of the introduced chicken ecotypes/ crossbreds. 6) Animal (egg and meat protein) intake/household/week 7) Reduced social conflicts due to income- generation from chicken- based projects across gender.	UDOM

Deliverables:	Means of verification	End date
3- community chicken breeding models established and tested in each of Galapo, Dareda and Matufa (Babati), Mlali (Kongwa) and Mwanya (Kiteto) action sites	Field report Project progress report	Feb. 2019
2) 4 local chicken ecotypes domesticated and evaluated across at least three action sites in Kongwa, Kiteto and Babati districts	Field survey report	Jun. 2019
3) At least 2 chicken crossbreds developed and their performance tested across at least three action	Filed report	Apr. 2019

sites in Kongwa, Kiteto and Babati districts		
At least 1 local chicken- meat strain chicken ecotype developed and evaluated	Field report and progress report	Apr. 2019
A sample of chicken qualitative traits based on plumage colour, body shape/ conformity, comb type, comb shape, ear lobe shape, ear lobe colour, beak type and shape, eye colour are established	Field report Project progress report	Mar. 2019
Samples of chicken quantitative traits associated with physical characteristics (body weight, body length, shank length, shank colour) are quantified	Field report Project progress report	May 2019
Analysis on egg quality based on physical characteristics (egg weight, shell weight, shell colour, shell strength, albumen weight, yolk weight, yolk colour) of 100 chicken from every 3 trains for physical characteristics is established halfway the project	Field report Project progress report	Mar. 2019
A sample of egg quality based on chemical characteristics (albumen pH, albumen protein, yolk protein, mineral composition) of 200 chicken from each 3 chicken ecotypes is established	Laboratory report Field report Project progress report	Jun. 2019
The number of eggs sold at the household level at the end of project operation is increased from the current.	Field report	Jun. 2019
The number of chicks produced at the household level at the end of project operation is increased from the current.	Field report	May 2019
The number of chickens domesticated at household level should have increasedwhen the project finishes	Field report	Mar. 2019
At least 20 women from each of the participating 5 action sites are involved in poultry keeping.	Field report	Mar. 2019
The income of about 20-30 farmers in each of the 5 action sites is improved through chicken keeping.	Field report	Aug. 2019
About 20-30 households from the participating 5 action sites have	Field report	Jun. 2019

increased egg-protein/meat-protein intake.		
The amount of money used in poultry disease treatment is reduced from current after project operation	Household income performance reports	Apr. 2019
Poultry housing and practices of about 20-30 farmers from each 5 action sites are improved.	Field report	Aug. 2019

How will scaling be achieved?

- Partnership with the respective districts' councils for Kongwa, Kiteto and Babati districts
- Partnership with AKTM Company for Kuroiler birds' egg/meat chicken strain
- Partnership with Silverland Tanzania for Sasso egg/meat chicken strain

How are the activities in this protocol linked to those of others?

- Integrated community chicken breeding and the local-exotic chicken crossbreds that will be developed and tested across the action sites in the three districts are validated by the feeding trial (ILRI),
- Eggs quality, egg and meat intake are linked to the SUA nutrition Cohort study among lactating mothers and five- year old children.
- Production of chicken manure and their utilization for soil fertility improvement linked to soil fertility improvement

Outcome 1: Project Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability				
Output 1.1	Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies [and scaled in Outcomes 4 and 5			
Activity 1.1.2	Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, and forages			
Sub-activity: ILRI Dairy 1	To test the effect of feeding Napier grass and Maize stover supplemented with bean haulms at different levels on milk yield under smallholder farmer conditions			
Systems research team:				
Name	Institution	Role		
Ben Lukuyu	ILRI	PI		
Leonard Marwa	TALIRI – West Kilimanjaro	Technical backstopping on livestock feeding trials		
Data collection clerk	To be recruited locally	Farmer mobilisation, full-time data collection and entry and backstop farmer trainings		
Student(s):				
Name	Institute	Degree	Start	End

Location(s):	Long, Sabilo and Seloto villages
Start date	2018
End date	2020

Justification: See Protocol

Objectives: See protocol

Research questions: See Protocol

Experiment design, implementation and data analysis: See Protocol

Data (with metrics) to be collected and uploaded on Dataverse

	Responsible institution
Productivity*:** ***Animal productivity - Animal products (amount /animal /year) - Animal by-products (amount /animal /year) - Rating of animal productivity	ILRI and UDOM
Economic: ***Profitability*** - Profitability (gross margin of diets expressed in $/treatment ***Labor requirement*** - Labor requirement (hours/day) - Farmer rating of labor	ILRI and UDOM
Social: ***Gender equity*** - Time allocation by gender - Income by gender ***Equity*** - Rating of technologies by group	ILRI and UDOM
Human Condition: ***Food security and nutrition*** - Milk production at farm level expressed as calories/cow/year and using available literature to derive protein output (g/cow)	ILRI

Deliverables:	Means of verification	End date
Ethical approval	Ethical approval certificate	February 2019
A total of 32 cows selected. Initiate animal weight and stage of lactation data taken at the beginning of the trial and used to select and allocate animals to treatments.	Report on farms and experimental cows' selection and allocation to treatments	March 2019

At least 25 trial farmers, 4 Extension and 1 data collection clerk trained on cow management, feeding procedure and data collection during the experiment	Training report	April 2019
Experimental diets evaluated by farmers	Evaluation report	June 2019
Nutritive value of diets evaluated	Nutritive value data set	July 2019
Feeding trials completed	Productivity data sets	August 2019
Data analysis completed	Technical report	September 2019

How will scaling be achieved?
Partnership with COSITA and World Vision to deliver training about technology to 500 farmers
How are the activities in this protocol linked to those of others?
The feeding of crop residues (maize stover and bean haulms) are outputs of the topping and fertilizer experiments by ILRI.

Sub-activity 1.1.2.1-WorldVeg	**Assessment of the benefits of technologies on performance of different vegetable varieties**	
Research team		
Name	Institution	Role
J. Ochieng	WorldVeg	PI
J. Ludovic	Iles de Paix (IDP)	Fund and facilitate establishment of research trials and backstopping on vegetable technologies. MOA/crops officer, P. Wyda is a partner of IDP and will backstop the R4D activities.
F. Muthoni (GIS specialist)	IITA	Produce regionally relevant extrapolation domain maps for validated vegetables technologies.
A. Sambala (M&E specialist)	IITA	Support in monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with critical gender perspective and uploading into the FtF system.

Students:				
Name	Institute	Degree	Start	End

Location	8 Villages in Karatu: Kambi ya samba, Bashay, Buger, Gyekrumlambo, Slahhamo, Rhotia Kainam, Chem, Changarawe
Start date	2019
End date	2019
Justification: See Protocol	
Objectives: See protocol	
Research questions: See Protocol	
Experiment design, implementation and data analysis: See Protocol	
Data (with metrics) to be collected and uploaded on Dataverse	
SI-Domain	Responsible institution
Productivity: • Crop productivity: Vegetable yield at plot level (kg/ha/season) • Data to be collected: Yield per crop • Date of flowering and maturity, Number of plants harvested	WorldVeg
Economic: • Profitability: Gross margin/CBA at plot level ($/crop/ha/season) • Data to be collected: Labour input in hours per week, costs of inputs (staking for tomato, water, fertilizers, seeds, harvesting, etc.), price of each marketable crop	WorldVeg
Environmental: • Pest levels: Pest abundance and severity by type; • Pesticide use: active ingredient applied (kg/ha) • Data to be collected: Pest management data (see protocol)	WorldVeg
Human Condition: • Nutrition: Access to nutritious foods- ○ Amount of vegetable	WorldVeg

consumption per capita (g/day) ○ Vegetable consumption diversity (no. consumed per day) • Data to be collected: Number of types of vegetables consumed and the amount consumed in 7 days		
Social: • Gender equity: Rating technologies by gender • Data to be collected: Technology ratings by men and women through FGD	WorldVeg	
Deliverables:	Means of verification	End date
Performance (Yield and profitability) of vegetable production using improved technologies in Karatu established	Report on the performance of the research trials	Sep. 2019
At least 128 lead farmers, 8 government extension officers and 3 partners (NGO) staff trained on safe production of vegetables	Training report	Jun. 2019
Two farmer field days conducted	Farmer field day reports	Apr. 2019 & Sep. 2019
At least 1 success/blog story	Success story submitted to Africa RISING Comms specialist	Sep. 2019
How will scaling be achieved?		
Island of Peace (IDP) an NGO in Karatu will scale the technologies/practices in Karatu and other regions where they have activities. These technologies will be scaled to another 16 producer organizations in eight (8) new villages with a total membership of 450 farmers. IDP is working with RECODA which can potentially disseminate the technologies.		
How are the activities in this protocol linked to those of others?		
Good agronomic practices for new traditional African vegetables (TAV) varieties are being validated by Mboga na Matunda (MnM) project led by WorldVeg and TAHA in Zanzibar.		

Sub-activity 1.1.2.2-WorldVeg	**Assess the efficacy of a nethouse and biopesticides in controlling *Bemisia tabaci* and *Tuta absoluta* on solanaceous vegetables**	
Research team		
Name	Institution	Role

J. Ochieng	WorldVeg	PI
C. Paulo (Shaurimoyo) A. Roman (Matufa) E. Mmary (Bermi	MoA/DAICO offices	Backstop R4D activities in three villages
A. Sambala (M&E specialist)	IITA	Support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system

Students				
Name	Institute	Degree	Start	End

Location	3 villages in Babati (Shaurimoyo, Bermi and Matufa)
Start date	2017
End date	2019

Justification: See Protocol

Objectives: See protocol

Research questions: See Protocol

Experiment design, implementation and data analysis: See Protocol

Data (with metrics) to be collected and uploaded on Dataverse

SI-Domain	Responsible institution
Productivity: • Crop productivity: Vegetable yield (kg/ha/season) • Data to be collected: Yield per crop, Date of flowering and maturity, Number of plants harvested.	WorldVeg
Economic: • Profitability: Gross margin at plot level ($/ha/season) • Data to be collected: Labour input in hours per week, costs of inputs (staking for tomato, water, fertilizers, seeds, harvesting,	WorldVeg

etc.), the price of each marketable crop	
Environmental: • Pesticide use: active ingredient applied (kg/ha) • Pest levels: pest abundance and severity by type • Data to be collected: Pest management data (see protocol)	WorldVeg
Social: • Gender equity: Rating of technologies by gender • Data to be collected: Technology ratings by men and women through focus group discussion (FGD)	WorldVeg
Human condition	

Deliverables:	Means of verification	End date
Performance (Productivity and economic) of vegetable production using improved technologies (Net house and biopesticides).	Report on the performance of the research trials	Aug. 2019
At least 50 farmers trained directly, 4 government extension officers and partner staff trained on the two technologies	Training report	Jun. 2019
1 farmer field day conducted	Farmer field day report	May 2019
Draft journal article	Draft article submitted to the Africa RISING chief scientist	Sep. 2019

How will scaling be achieved?

Friends in Development Trust Fund (FIDE) will scale the technologies in Babati where they have activities. IDP will also scale the technologies to progressive farmers in Karatu that will be identified.

How are the activities in this protocol linked to those of others?
A WorldVeg led project is currently testing the low net tunnels with about 50 farmers producing cabbages in Arumeru.

Activity 1.1.2 (Changed from original 1.1.1)	Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, and forages

Sub-activity – SUA 1	**Monitoring the impact of weather and climate variability on the productivity and resilience of maize-legume cropping systems of Kongwa and Kiteto, Tanzania.**			
Systems research team:				
Name	**Institution**	**Role**		
Mawazo J. Shitindi	SUA	PI, designing and leading the research, supervising graduate student (research assistant) and overseeing the project activities		
Francis Muthoni	IITA	Technical backstopping on modelling the impact of weather variability on performance and resilience of maize legume-based cropping systems		
Anthon Kimaro	ICRAF	Technical backstopping and providing historical maize and legume productivity and resilience data from Gliricidia-based cropping systems		
Elirehema Swai	TARI Hombolo	Technical backstopping and providing historical maize - legume productivity data from soil water management technologies		
	ICRISAT	Source of pigeon peas and groundnut varieties for research		
DAICO's	Kongwa and Kiteto DC.	Backstopping of maize-legume – historical productivity data for modelling		
Anicet Sambala	IITA	To support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and custom indicators data) with a critical gender perspective and uploading into the FfF system		
Student(s):				
Name	Institute	Degree	Start	End
Mushi Revocatus	SUA	MSc. Soil Science and Land Management	Jan. 2019	Nov. 2021
Location(s):	Mlali village of Kongwa district and Njoro village of Kiteto District			
Start date	2018 - new sub activity building on what has been done by TARI Hombolo and ICRAF since 2014			
End date	2021			
Justification: See Protocol				
Objectives: See protocol				
Research questions: See Protocol				
Experiment design, implementation and data analysis: See Protocol				
Data (with metrics) to be collected and uploaded on dataverse				

		Responsible institution
Productivity: • Historical and current maize, pigeon peas and groundnut grain and Stover or wood yield (t/ha)		SUA
Environmental: • Variability of key weather elements including rainfall (mm/day/week/month/season/year); Rainfall distribution (Number of rain days/ weeks/months in a season or year); Maximum and minimum temperature (^{o}C); Daily, monthly and annual temperature range (^{o}C), photosynthetically active radiation (PAR)		SUA & IITA
Economic: • Profitability (gross margin in USD/ha) associated with variability of weather elements.		SUA
Social: Gender perception of weather variability and associated impacts on crop productivity		IITA
Human Condition: Food availability (number of food sufficiency month per household/year)		SUA
Deliverables:	Means of verification	End date
Historical weather and crop yield data	Data sets	Mar. 2019
The level of understanding of weather/climate variability and associated impacts on cereal and legume production among the communities in Kongwa and Kiteto districts established	Survey report	Apr. 2019
One automated weather station installed in each research site (Kongwa and Kiteto) and current weather is recorded on a monthly basis	Monthly weather data	Dec. 2018 – Aug. 2019
At least 12 lead farmers, 3 extension workers and 2 research assistants trained on the use of automated weather stations, weather/climate variability and mitigation of associated impacts on crop production.	Training report	Jun. 2019
Variability of weather/climate and associated impacts on the yield of maize, pigeon peas and other food legumes traced in Kongwa and Kiteto.	Weather variability and crop yield data sets	Aug. 2019

How will scaling be achieved?
Partnership with District Agricultural and Livestock Development offices (DAICOs), TMA and agricultural based NGOs
How are the activities in this protocol linked to those of others?

Choice crop varieties for testing the impact of weather variability on crop yield are validated with crop improvement (ICRISAT) and agronomic practices for the new varieties are validated with the S&WC (TARI Hombolo).

Sub-activity – SUA 2	Assessing the integrative effect of in-situ rainwater harvesting and fertilizer micro-dosing on crop yield, water and nutrient use efficiency in Kongwa District.			
Systems research team:				
Name	Institution	Role		
Mawazo J. Shitindi	SUA	PI designing the research, supervising graduate student (research assistant) and overseeing the project activities)		
Anthony Kimaro	ICRAF	Co-researcher to provide technical support on maize legume intercrops and secondary data on fertilizer micro-dosing and crop productivity.		
Elirehema Swai	TARI Hombolo	Co-researcher to provide technical support on designing and managing rainwater harvesting infrastructures.		
Kotu Bekele	IITA	Backstopping on the economics of integrating rainwater harvesting with fertilizer micro-dosing in maize-legume cropping systems of Kongwa and Kiteto.		
Gundula Fischer	IITA	Technical support on assessing social economics of integrating rainwater harvesting and fertilizer micro-dosing and perception of the technology, labor requirement and returns on labor investment		
Dr Christopher	IITA	Assessing nutritional value and food safety properties of maize, pigeon peas and groundnuts produced from the research work using resources from IITA		
Anthony Kimaro	ICRAF	Technical backstopping and providing historical maize and legume productivity and resilience data from Gliricidia-based cropping systems		
Anicet Sambala	IITA	To support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with critical gender perspective and uploading into the FfF system		
Student(s):				
Name	Institute	Degree	Start	End
Mushi Revocatus	SUA	MSc. Soil Science and Land Management	Jan. 2019	Nov. 2021
Location(s):	Mlali village of Kongwa District and Njoro village of Kiteto District			
Start date	December 2018 - new sub activity building on what has been done by TARI Hombolo and ICRAF since 2014			
End date	November 2021			

Justification: See Protocol		
Objectives: See protocol		
Research questions: See Protocol		
Experiment design, implementation and data analysis: See Protocol		
Data (with metrics) to be collected and uploaded on data verse		
		Responsible institution
Productivity: • Maize, pigeon peas and groundnut grain and stover or wood yield (t/ha); nutrient use efficiency (kg/g of fertilizer/nutrient used); rainwater use efficiency (kg of grain and biomass/mm/year)		SUA
Environmental: • Crop nutrient uptake and nutrients exported out of the fields (kg/ha)		SUA
Economic: • Profitability of technology (gross margin in USD/ha); Cost-Benefit ratio (USD/USD).		IITA
Social: Feasibility and acceptability of the technology (numbers of farmers by gender and age groups) returns on labor investment (USD/person day); accessibility and use of fertilizers (kg/ha/individual farmer); number of farmers using fertilizers.		IITA
Human Condition: Nutritional value [protein and micronutrients (g/ha)] and food safety [aflatoxin analysis (µg/kg)] of the products to be done by IITA on produce samples collected during harvest		IITA - produce samples provided for analysis using own (IITA's) resources
Deliverables:	*Means of verification*	End date
Research protocol and work plan developed	Submission of research protocol and work plan	Dec. 2018
Farmers mobilized, experimental sites identified, and field experiments conducted	Number of experiments conducted and farmers involved in the research	31 Aug. 2019
The feasibility of integrating in-situ rainwater harvesting and fertilizer micro-dosing technologies	Assessment report	31 Aug. 2019
Data sets for the first year (2018/2019) uploaded	Uploaded data set	31 Aug. 2019.

At least two farmer field days and one research partner meeting conducted each year	Farmers' field day and partner meeting reports	31 May 2019
Research results for year 1 presented at the annual project meeting and scientific conferences.	Presentations made	Sep. 2019
How will scaling be achieved?		
To scale this activity; development partner interested in the activity will be thought to help in taking it to scale.		
How are the activities in this protocol linked to those of others?		
Choice crop varieties for testing the proposed technology are validated with crop improvement (ICRISAT) and agronomic practices for the new varieties are validated with the S&WC (TARI Hombolo) and Fertilizer micro-dosing (ICRAF).		

Outcome 1: Project Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability		
Output 1.2	Demand-driven, labor-saving and gender-sensitive research products to reduce drudgery while increasing labor efficiency in the production cycle piloted for relevant typologies in target areas [and scaled in Outcomes 4 and 5]	
Activity 1.2.1	Support local partners through training on appropriate drudgery-reducing technology delivery	
Sub-activity 1.2.1.2	**Validation of residual tied ridging as a labour-saving technology in semi-arid Areas of Central Tanzania**	
Systems research team:		
Name	Institution	Role
Elirehema Swai	TARI Hombolo	PI - responsible for research design and oversight of the project activities
Lutengano Edward Mwinuka	University of Dodoma	Involved in economic data collection at Kiteto and Kongwa districts
Africa RISING Economist	IITA	Backstopping UDOM economist on economic data collection
Gundula Fischer	IITA	Gender analysis and technical backstopping to social scientists from the University of Dodoma who will be engaged for data collection and evaluation
Mawazo Shitindi	Sokoine University of Agriculture	Will provide technical backstopping on the soil fertility status of experimental sites
Christoper Mutungi	IITA	Responsible for human condition SI domain; at harvest, he will collect maize grain samples from different technologies for nutrition analysis
Anicet Sambala	IITA	To provide support in the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system
Location(s):	Laikala, Mlali, Ngumbi and Sagara villages in Kongwa District	

Start date	2016/2017
End date	September 2021

Justification: See Protocol 1

Objectives: See protocol 1

Research questions: See Protocol 1

Experiment design, implementation and data analysis: See Protocol 1

Data (with metrics) to be collected and uploaded on Dataverse:

	Responsible institution
Productivity Crop Productivity: Maize grain yield (kg/ha/season) Crop biomass productivity: Maize stover yield (kg/ha/season)	TARI Hombolo
Environment Soil physical quality: Soil bulk density (g/cm3) Water availability: Cumulative infiltration (mm); soil moisture content (%); rainwater use efficiency (kg/mm/yr); water productivity	TARI Hombolo
Economic Profitability: Gross margin (USD/ha)	University of Dodoma/IITA
Social Gender equity: Farmers perception on labor requirement on the use of residual tied ridging technology segregated by gender	IITA
Human Condition Nutrition: Protein production (g/ha); micronutrient production (g/ha) Food security: Food production (calories/ha/yr)	IITA

Deliverables:	Means of verification	End date
At least thirty (30) experimental plots both mother and baby trials on the use of residual tied ridging tillage technology initiated in Kongwa District during 2018/2019 cropping season.	Quarterly report	Feb. 2019
Accrued social and economic benefits of using residual tied ridging technology segregated by gender quantified.	Progress Report	Sep. 2019
Information on productivity, environment, and social benefits associated with the use of residual tied ridging technology in Kongwa District in areas of Dodoma Region quantified.	Progress Report	Sep. 2019
Information on the effect of residual tied tillage technique on protein content, micronutrient content, and food safety available.	Progress Report	Sep. 2019

Farmers Field days (FFDs) conducted in at least two participating villages.	Field day report	Apr. to May 2019
How will scaling be achieved?		
Through the involvement of ward/village extension officers and councillors in Kiteto and Kongwa District Councils. Similarly, farmers' fields days will be conducted to showcase best practices and thus will engage farming communities in the project area as well as neighboring villages.		
How are the activities in this protocol linked to those of others?		
The *in-situ* rainwater harvesting technology is being validated with improved drought-tolerant maize variety (CIMMYT) as well as soil fertility management (SUA/ICRAF).		

Activity 1.2.2	Co-adapt existing mechanization options with target communities	
Sub-activity 1.2.2.1	**Use of tractor mounted ripper tillage implement for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto, Manyara Region**	
Systems research team:		
Name	Institution	Role
Elirehema Swai	TARI Hombolo	Responsible for research design and oversight of the project activities
Gundula Fischer	IITA	Gender analysis and farmers perceptions
Africa RISING Economist	IITA	Backstopping UDOM economist on economic data collection
Mawazo Shitindi	Sokoine University of Agriculture	Technical support on the soil fertility status
Lutengano Edward Mwinuka	University of Dodoma	Involved in economic data collection at Kiteto and Kongwa districts
Christopher Mutungi	IITA	Responsible for human condition SI domain
Anicet Sambala	IITA	To provide support in the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system
Location(s):	Kiperesa village in Kiteto District	
Start date	2016/2017	
End date	Sept 2021	
Justification: See Protocol 2		
Objectives: See protocol 2		
Research questions: See Protocol 2		
Experiment design, implementation and data analysis: See Protocol 2		
Data (with metrics) to be collected and uploaded on Dataverse:		
		Responsible institution
Productivity Crop productivity: Maize grain yield (kg/ha/season)		TARI Hombolo

Crop biomass productivity: Maize stover yield (kg/ha/season)		
Environment Soil physical quality: Soil bulk density (g/cm^3); cumulative infiltration (mm); soil moisture content (%); rainwater use efficiency (kg/mm/yr); water productivity		TARI Hombolo and SUA Morogoro
Economic Profitability: Gross margin (USD/ha).		University of Dodoma/IITA
Social Farmers perception on use of rip tillage technology segregated by gender		IITA
Human Condition Nutrition : Protein production (g/ha); micronutrient production (g/ha)		IITA
Deliverables:	Means of verification	End date
One mother trial and 10 baby trials under rip tillage technique using tractor mounted ripper established in Kiteto District Council	Quarterly report	Feb. 2019
Socio-economic benefits of using rip tillage (tractor mounted ripper) technology segregated by gender established	Progress Report	Sep. 2019
Accrued benefits on productivity, environment, and social domains associated with the use of rip tillage technology quantified in semi-arid zones of Kiteto in Manyara Region	Progress Report	Sep. 2019
Effect of rip tillage techniques on protein content, micronutrient content, and food safety established	Progress Report	Sep. 2019
Field days conducted in at least two participating	Field day report	May 2019
How will scaling be achieved? Through engagement of ward/village extension officers and councillors in Kiteto District in Manyara Region.		
How are the activities in this protocol linked to those of others? The rip tillage technology is being validated with improved drought-tolerant maize variety (CIMMYT).		

Outcome 2

Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies				
Output 2.1:	Demand-driven research products for enhancing soil, land and water resources management to reduce household/community vulnerability and land degradation piloted in priority agro-ecologies [and scaled in Outcome 5]			
Activity 2.1.1:	Characterize current practices in ESA through identifying formal and informal arrangements for access to and use of water and land resources			
Sub-activity – SUA 3	**Evaluation of land rehabilitation benefits of shelterbelts and contours (Soil and plant sampling from ICRAF and TARI Hombolo sites).**			
Systems research team:				
Name	Institution	Role		
Mawazo J. Shitindi	SUA	Lead researcher coordinating sampling processes and overseeing laboratory analysis and research report production		
Anthony Kimaro	ICRAF	Co-researcher to provide technical backstopping on the design of shelterbelt and contour demo plots, baseline data of soil properties and general classification of soils in the study area.		
Elirehema Swai	TARI Hombolo	Co-researcher to provide technical backstopping on the design of soil water conservation demo-plots and baseline data of soil properties in the study area before initiation of contour bunds		
Anicet Sambala	IITA	To support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FfF system		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	Mlali Molet and Laikala villages of Kongwa district			
Start date	October 2017 (New sub activity building on what has been done by TARI Hombolo and ICRAF since 2014)			
End date	September 2020 for a full project cycle			
Justification: See Protocol				
Objectives: See protocol				
Research questions: See Protocol				
Experiment design, implementation and data analysis: See Protocol				

Data (with metrics) to be collected and uploaded on dataverse		
		Responsible institution
Productivity: Crop yields (t/ha) of grain and stover of wood		SUA
Environmental: Nutrient availability (mg/kg soil); Soil carbon (g/kg soil); Nutrient input through litter fall; soil loss kg/ha/year); nutrient uptake and nutrient exported out of the fields (kg/ha) and reduced soil loss (kg/ha)		SUA
Economic: Profitability of technology (gross margin in USD/ha); Cost-Benefit ratio (USD/USD).		IITA
Social: Farmers perceptions of the environmental and economic benefits of the shelterbelt and contours (Numbers by gender and age groups); returns on labor investment (USD/person day)		IITA
Deliverables:	*Means of verification*	End date
Research protocol developed	Submitted research protocol	Dec. 2018
Soil and plant sampling conducted for laboratory analysis	Soil and plant samples registered in the laboratory	Jan. 2019
Laboratory analyses conducted and data sets for the first year (2018/2019) uploaded	Data sets uploaded and report on land rehabilitation benefits of shelterbelts and contours	31 Aug. 2019
Assessed soil erosion control benefits of contours and shelterbelts and linked to land rehabilitation processes and social - economic benefits of the technologies	Annual report	Sep. 2019

How will scaling be achieved?
Development partner interested in this activity will also be thought to help in taking it to scale and partnership with DAICOs to disseminate the technology using demonstration plots and extension materials.
Linkage of the activities in this protocol to those of others:
Agronomic practices (ICRAF); Shelterbelts and contours evaluated for land rehabilitation benefits are currently part of studies on Integrating fodder tree and grass forage species in dryland farming (ICRAF) and S&WC (TARI Hombolo)

Output 2.1	Demand-driven research products for enhancing soil, land and water resources management to reduce household/community vulnerability and land degradation piloted in priority agro-ecologies [and scaled in Outcome 5]	
Activity 2.1.1	Characterize current practices in ESA through identifying formal and informal arrangements for access to and use of water and land resources	
Sub-activity 2.1.1.2	**Land rehabilitation through the integration of fodder trees and grass forage species in dryland farming**	
Systems research team:		
Name	Institution	Role

A. Kimaro	ICRAF	PI, Research design and oversight of project activities
E. Temu	ICRAF	Contribute to socio-economic, gender and labor studies
Kotu Bekele	IITA	Technical backstopping on economic analyses (Section 3-protocol)
Gundula Fischer	IITA	Technical backstopping on gender and labor analyses (Section 3-protocol)
F. Muthoni	IITA	Technical support on GIS-based soil erosion mapping (Section 3-protocol)
L. Claessens	IITA	Technical support on system analysis of contour farming at Moshi Maile site, Mlali
Anicet Sambala		Support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system

Student(s): NA	
Location(s):	Mlali village in Kongwa District
Start date	October 2017
End date	September 2020

Justification: See protocol

Objectives: See protocol

Experiment design, implementation and data analysis: See Protocol

Data (with metrics) to be collected and uploaded on dataverse

SI Domain	Responsible institution
Productivity: Maize grain and stover yield (t/ha); wood and foliage biomass (t/ha)	ICRAF
Environmental: Soil fertility (g/kg-soil); Soil moisture (%), Rainwater use efficiency (kg/mm/yr); Nutrient uptake (kg/ha); Nutrient use efficiency (kg/uptake); weather data; GPS points	ICRAF, SUA and IITA
Economic: Gross margin in USD/ha and Benefit-Cost Ratio-BCR;	ICRAF and IITA
Social: Food availability (number of food sufficiency month per household/year)	ICRAF and IITA
Human Condition: Perception of benefits of the technology by gender	ICRAF and IITA

Deliverables:	Means of verification	End date
Co-organized farmer field day and Nane-nane exhibition	Activity/progress report	May and Aug., 2019

Farmer-to-farmer exchange on agroforestry education facilitated	Activity/progress report	Jun. 2019
Effect of various contour components on productivity (biomass and grain yields) determined	Activity/progress report	Aug. 2019
Soil restoration benefits (soil fertility and erosion) of contour farming assessed	Activity/progress report	Aug. 2019
Economic benefits of two model contour farms integrating *G. sepium* and grass fodder evaluated	Activity/progress report	Sep. 2019
Gender analysis of at least 10 farmers with contours completed	Activity/progress report	Sep. 2019
How will scaling be achieved?		
ICRAF will work with the Dorcas group at Mlali, TANAPA (Kilosa), VAEOs and DAICOs in Kongwa to deliver at least 10,000 seedlings and agroforestry education to non-AR sites (e.g., Ngumbi, and Kitete Msindazi villages)		
How are the activities in this protocol linked to those of others?		
Test crop (Maize variety and pigeonpea) to be used in this trial are promising variety selected by ICRISAT and CIMMYT. *G. sepium* fodder is use in pen goat feeding trials in Malawi and similar work can be adopted for Kongwa for draught animals, which needs supplementary feeding for high productivity. Also used in poultry feeds in the KK/Babati poultry feed experiments		

Output 2.2	Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5]	
Activity 2.2.1	Set up demonstration and learning sites in target ESA communities	
Sub-activity 2.2.1.1	**Demonstrate technologies on soil and water conservation for enhancing resilient to climate change in semi-arid agro-ecologies of Central Tanzania**	
Systems research team:		
Name	Institution	Role
Elirehema Swai	TARI Hombolo	Responsible for research design and oversight of the project activities
Gundula Fischer	IITA	Gender analysis and farmers perceptions
Anicet Sambala	IITA	To provide support in the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system
Location(s):	Laikala, Mlali, Nghumbi and Laikala villages in Kongwa District	
Start date	2014/2017	
End date	Sept 2021	

Justification: See Protocol 3		
Objectives: See protocol 3		
Research questions: See Protocol 3		
Experiment design, implementation and data analysis: See Protocol 3		
Data (with metrics) to be collected and uploaded on Dataverse:		
		Responsible institution
Economic Profitability: Gross margin (USD/ha)		University of Dodoma/IITA
Social Gender equity: Farmers perception of technologies/information segregated by gender		IITA
Deliverables:	Means of verification	End date
Socio-economic study on the use of terrace technology segregated by gender conducted	Progress Report	Sept 2019
How will scaling be achieved?		
Sharing of research findings with key stakeholders in Kiteto and Kongwa districts for informed decision making.		
How are the activities in this protocol linked to those of others?		
It is built upon the ongoing soil and water management initiatives in Kiteto and Kongwa districts.		

Output 2.2	Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5]			
Activity 2.2.1	Set up demonstration and learning sites in target ESA communities			
Sub-activity 2.2.1.1	**Investigations on nutrient and water management for climate resilience along a climate gradient in southern Malawi**			
Systems research team:				
Name	Institution	Role		
Regis Chikowo, Sieg Snapp	MSU	PIs, lead overall work		
ESA Economist	IITA	Backstopping on economic evaluation		
Gundula Fischer	IITA	Technical backstopping on gender acceptability of technologies		
Anicet Sambala	IITA	M&E		
Lieven Claessens	IITA	Ex-ante impact assessment with Tradeoff Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD) for regional relevance of Africa RISING technologies		
Student(s):				
Name	Institute	Degree	Start	End

Location(s):	Lithipe, Kandeu, Mtubwi, Nsanama, Nyambi, Extension Planning Areas (EPAs)
Start date	October 2016
End date	September 2020

Justification: See Protocol D

Objectives: See protocol D

Experiment design, implementation and data analysis: See Protocol D

Data (with metrics) to be collected and uploaded on dataverse

SI Domain	**Responsible institution**
Productivity: Maize and groundnut grain productivity (kg/ha/season), maize and groundnut biomass productivity (kg/ha/season); variability of production (CV); nitrogen use efficiency (kg grain/kg N applied)	MSU
Environmental**:** Water availability (soil moisture by treatment); biological N2-fixation (kg N/ha/season, rating of soil erosion	MSU
Economic: Profitability- Gross margin ($/ha/season; Benefit-Cost Ratio; Farmers' rating of labor	MSU and IITA
Social: Rating of technologies by gender	MSU and IITA
Human Condition: Nutrition- protein production (g/ha); Food security - food production (calories/ha/year)	MSU

Deliverables:	**Means of verification**	**End date**
Field protocols updated and available	Field protocols,	Jan. 2019
At least one nutrient x water management trial established per EPA	Field trials established	Jan. 2019
Field days held with partners	Field day reports	May 2019
Soil water and nutrients use interactions assessed	Draft publication	Sep. 2019
At least 10,000 farmers practicing tied ridges across projects sites (District Agriculture Extension Coordination Committees disseminating technology beyond Africa RISING project sites)	DAECC reports/feedback	Sep. 2019
How will scaling be achieved?		
Malawi extension system mainstreaming activities in different districts; Total Land Care and other NGOs will be exposed to the technology for possible scaling; CIMMYT has direct interests in maize intensification and can potentially scale this to other districts (and countries); Modelling based on soil and water management trials disseminated in the form of a scientific publication.		

How are the activities in this protocol linked to those of others?		
CIAT mainstreaming water management in common bean intensification; water management technologies also being implemented in Africa RISING Tanzania		

Output 2.2	Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5]			
Activity 2.2.1	Set up demonstration and learning sites in target ESA communities			
Sub-activity 2.2.1.2	Rainfall-responsive nitrogen fertilization strategies: in search of increased nitrogen use efficiency by smallholder farmers under rainfed conditions			
Systems research team:				
Name	Institution	Role		
Regis Chikowo, Sieg Snapp	MSU	PIs, research conceptualization and implementation		
ESA Economist	IITA	Backstopping on economic evaluation		
Anicet Sambala	IITA	M&E		
Lieven Claessens	IITA	Ex-ante impact assessment with Tradeoff Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD) for regional relevance of Africa RISING technologies		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	Lithipe, Kandeu, Mtubwi, Nsanama, Nyambi, Extension Planning Areas (EPAs)			
Start date	October 2017			
End date	September 2020			
Justification: See Protocol E				
Objectives: See protocol E				
Experiment design, implementation and data analysis: See Protocol E				
Data (with metrics) to be collected and uploaded on dataverse				
SI Domain				**Responsible institution**
Productivity: Maize grain productivity (kg/ha/season), maize biomass productivity (kg/ha/season); variability of production (CV); nitrogen use efficiency (kg grain/kg N applied)				MSU
Environmental**:** Soil moisture availability (soil moisture by treatment)				MSU
Economic: Profitability- Gross margin in $/ha/season; Benefit-Cost Ratio; Farmers' rating of labor (related to labor for multiple N side-dressing)				MSU and IITA
Social: Rating of technologies by gender				MSU
Human Condition: Food security (calorie production kg/ha/season)				MSU

Deliverables:	**Means of verification**	**End date**
Field experiments established	Field plans, protocols	Jan. 2019
Soil moisture probes installed on at least 2 sites	Probes physically in the field; data downloaded every month	Apr. 2019
Field days held with partners	Field day reports	May 2019
Soil water and nutrients use interactions assessed	Draft publication	Sep. 2019
How will scaling be achieved?		
This technology can be scaled countrywide through an existing Airtel 321 agriculture information service, therefore once efficacy proved, the next step would be to engage Airtel, as well as the national Extension Services of the Ministry of Agriculture		
How are the activities in this protocol linked to those of others?		
This is a novel system not yet widely used. We are piloting the technology. However, all other protocols are using the same principle on increasing resource use efficiencies		

Output 2.2	Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5]			
Activity 2.2.1	Set up demonstration and learning sites in target ESA communities			
Sub-activity 2.2.1.3	Assessing the effect of residue quantity and quality, and water conservation on maize productivity and nitrogen dynamics on smallholder farms in Malawi			
Systems research team:				
Name	Institution	Role		
Regis Chikowo, Sieg Snapp	MSU	PIs, research conceptualization and implementation		
ESA Economist	IITA	Backstopping on economic evaluation		
Anicet Sambala	IITA	M&E		
Lieven Claessens	IITA	Ex-ante impact assessment with Tradeoff Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD) for regional relevance of Africa RISING technologies		
Student(s):				
Name	Institute	Degree	Start	End
Chiwimbo Gwenambira	MSU	PhD	2016	2020
Location(s):	Lithipe, Kandeu, Mtubwi, Nsanama, Nyambi, Extension Planning Areas (EPAs)			
Start date	October 2016			
End date	September 2021			
Justification: See Protocol F				
Objectives: See protocol F				

Experiment design, implementation and data analysis: See Protocol F		
Data (with metrics) to be collected and uploaded on dataverse		
SI Domain		**Responsible institution**
Productivity: Maize grain productivity (kg/ha/season), maize biomass productivity (kg/ha/season); variability of production (CV); nitrogen use efficiency (kg grain/kg N applied)		MSU
Environmental**:** SOC content, biological N2-fixation estimates		MSU
Economic: Profitability- Gross margin in $/ha/season; Benefit-Cost Ratio; Farmers' rating of labor		MSU and IITA
Social: Rating of technologies by gender		MSU
Human Condition: Food security (calorie production ha/season)		MSU
Deliverables:	**Means of verification**	**End date**
At least one field trial established in the 5 EPA study sites	Protocol, field plans available	Jan. 2019
Field days held with partners	Field day reports	May 2019
Residue and nitrogen interactions assessed	Technical report	Sep. 2019
How will scaling be achieved?		
This technology will be scaled countrywide through the National Extension Services of the Ministry of Agriculture; also, Total Land Care and other NGOs; One Acre Fund interested in residue utilization		
How are the activities in this protocol linked to those of others?		
CIMMYT uses mulching as one of the three pillars of conservation agriculture. CIMMYT experiments with conservation agriculture and crop residues being implemented in Machinga district		

Outcome 3: Project Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households)		
Output 3.2	Nutritional quality improved through increased accessibility and use of nutrient-dense crops and livestock products	
Activity 3.2.2	Activity 3.2.1: Promote and deploy nutrient-rich crop varieties and livestock feed resources in target communities	
Sub-activity 3.1.2.1	**Assess the impact of nutritional messaging on farmers nutritional knowledge, attitude and practices and household nutrition status**	
Systems research team:		
Name	Institution	Role
J. Ochieng	WorldVeg	PI
J. Ludovic	Iles de Paix (IDP)	Fund and participate in nutrition training. Ministry of Health and Social Welfare (MoH&SW) are partnering with IDP in Karatu and will backstop nutrition-related activities.
C. Mutungi (Post-harvest specialist)	IITA	Contribute to training post-harvest handling of foods for improved nutritional outcomes and participate in baseline data collection.

A. Sambala	IITA	Support the monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with critical gender perspective and uploading into the FtF system		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	16 Villages in Karatu: 8 are listed while additional 8 villages will be identified by IDP. Kambi ya samba, Bashay, Buger, Gyekrumlambo, Slahhamo, Rhotia Kainam, Chem, Changarawe.			
Start date	2017			
End date	2019			
Justification: See protocol				
Objectives: See protocol				
Research questions: See protocol				
Experiment design, implementation and data analysis: See protocol				
Data (with metrics) to be collected and uploaded on Dataverse				

	Responsible institution
Productivity: Crop productivity: Vegetable yield (kg/ha/season) *Data to be collected:* ????	WorldVeg
Economic: • Income diversification: Income diversification index (Simpson index and number of income sources) • Market participation: Market orientation index (% of vegetables sold to the market Data to be collected: Sources of income, price of each marketable crop, quantity of vegetables sold	WorldVeg
Human condition: • Nutrition: Access to diverse foods -vegetables (#), Dietary diversity (score-0-12) • Capacity: % of farmers applying or experimenting improved nutritional practices Data to be collected: Vegetables produced, Food types consumed by the household in 24 hours, Number of farmers applying improved practices	WorldVeg
Social: • Nutrition outcomes by gender	WorldVeg

Data to be collected: Disaggregated nutrition outcomes by women and men		
Deliverables:	Means of verification	End date
Baseline survey	Baseline data in Dataverse	Mar. 2019
Number of households trained on nutrition including recipes. • One sensitization meeting per group • At least 450 farmers trained • At least two new vegetable-based recipes developed and promoted (excluding those developed by WorldVeg in the past). • At least four food kioks/restaurants incorporated in their food menu.	Training report, Sensitization meeting reports, Reports on recipes	Sep. 2019
At least 1 success/blog story	Success story online	Sep. 2019

How will scaling be achieved?
IDP will conduct nutrition messaging in other areas in Karatu. RECODA and MVIWATA are interested to incorporate nutrition messaging in their programs in Babati.
How are the activities in this protocol linked to those of others?

Outcome 3

Outcome 3: Options for equitable food and feed safety, nutritional quality and income security of target smallholder families improved		
Output 3.2	Nutritional quality due to increased accessibility and use of nutrient-dense crops by farmers improved	
Activity 3.2.1	Promote and deploy nutrient-rich crop varieties and livestock feed resources in target communities	
Sub-activity 3.2.1.1	**Elucidate pathways to sustainable adoption of nutrient diets and aflatoxin mitigation practices in rural communities of Central Tanzania**	
Name	**Institution**	**Role**
[a]Yacinta Muzanila	SUA (Co-PI)	Coordinate assembly of data from both research and monitoring activities
[b]Wanjiku Gichohi	ICRISAT (PI)	Coordinate assembly of data from both research and monitoring activities. Engage with other Africa RISING local and CGIAR partners
Anicet Sambala	IITA	To support the monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading of data into the FtF data management system
Location(s):	Babati, Kongwa, Kiteto	
Start date	2019	
End date	2019	
Justification: See protocols 6.1 and 6.2 and the studies described therein		
Objectives: See protocols 6.1 and 6.2 and the studies described therein		
Research questions: See protocols 6.1 and 6.2 and the studies described therein		
Experiment design, implementation and data analysis: See protocols 6.1 and 6.2 and the studies described therein		
Data (with metrics) to be collected and uploaded on dataverse		
Domain		Responsible institution
Economic: • Poverty: Per capita household consumption expenditure		ICRISAT
Social: • Gender equity: Agency: Time allocation by gender, Market participation by gender; Achievements: Income by gender; Nutrition/Food security by gender; Health status by gender • Social cohesion: Level and reliability of social support with gender integration		ICRISAT

Human Condition: • Nutrition: Dietary diversity, Availability of diverse food crops, Food consumption score, Nutritional status (underweight, stunting, wasting) Uptake of essential nutrients • Capacity to experiment: % of farmers experimenting	SUA

Deliverables:	**Means of verification**	**End data**
Training/technical capacity conducted	Report	30 Sep. 2019
Drivers of food choice in Kongwa, Kiteto, and Babati established	Report, draft manuscript	30 Sep. 2019
Household awareness and knowledge on complementary feeding, hygiene practices and aflatoxin mitigation documented	Report Draft manuscript	30 Sep. 2019
How will scaling and sustainability be achieved?		
Through. partnership with government and development partners to address gaps identified on food choice and utilization		
How are the activities in this protocol linked to those of others?		
Multi-team participation will be adapted during the implementation process to explore the synergies between the crop production and nutrition teams in influencing food choice and utilization		

Output 3.3	Output 3.3: Capacity of farming communities and partners to consume nutrient-dense crops and livestock products enhanced			
Activity 3.3.1	Conduct packaging and delivery of crop and fodder varieties and associated management practices through community and development partnerships with iterative reviewing and refining			
Sub-activity 3.3.1.1	Determining the quality and safety of locally produced legume grain-derived complementary foods and adoption in Dedza District			
Systems research team:				
Name	Institution	Role		
Agnes Mwangwela	LUANAR	PI, Nutrition outcome tracking studies/food quality/safety		
Rowland Chirwa	CIAT	Nutrient-dense common bean production research component		
Student(s):				
Name	Institute	Degree	Start	End
Frank Chilanga	LUANAR	MSc Nutrition	2018	2020

Location(s):	Linthipe EPA
Start date	January 2014
End date	September 2021

Justification: See Protocol H

Objectives: See protocol H

Research questions: See Protocol H

Experiment design, implementation and data analysis: See Protocol H

Data (with metrics) to be collected and uploaded on dataverse

SI Domain	**Responsible institution**
Productivity: NA	
Environmental: NA	
Economic: Food processing labor requirement (hours per meal for 6 persons	LUANAR
Social: Nutrition/Food security by gender; Capacity (access to information); Rating of technologies by group	LUANAR
Human Condition: Availability of diverse food crops; Food safety of finished products (aflatoxins (micrograms/kg); Dietary diversity; Uptake of essential nutrients; % of farmers experimenting	LUANAR

Deliverables:	**Means of verification**	**End date**
Improved household utilization of nutrient-dense recipes	One technical report/draft paper on household consumption and utilization of foods prepared from disseminated recipes	Aug. 2019
At least 2 field days held with nutrition groups, especially HIV/AIDS action groups in Linthipe, jointly with DNCC	Nutrition field day reports	Sep. 2019
3 recipes available	Recipe booklet available	Sep. 2019
Improved child nutrition status demonstrated	Report: Anthropometry and infant and young child feeding	Sep. 2019

How will scaling be achieved?

Collaboration with District Nutrition Coordinating Committees (DNCC to disseminate the recipes beyond Africa RISING intervention sites/EPAs

How are the activities in this protocol linked to those of others?

Legume grain used in nutrition training and value addition is derived from other components of the project, e.g. CIAT introduced nutrient dense common bean varieties

Outcome 4

Outcome 4: Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved.				
Output 4.1	Access to profitable markets for smallholder farming communities and priority value chains facilitated			
Activity 4.1.1	Conduct comprehensive value-chain analysis with a specific focus on SI technologies			
Sub-activity –4.1.1.1	**Conduct value chain analysis (VCA) for (nutrient dense) maize seed in Kongwa and Kiteto**			
Systems research team:				
Name	Institution	Role		
Bright Jumbo	CIMMYT	PI		
Patrick Okori/James Mwololo	ICRISAT	To work closely on similar ICRISAT led VCA for cereals (Sorghum) and legumes (groundnuts)		
Anicet Sambala	IITA	To support in monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system		
Gundula Fischer	IITA	To provide guidance on gender when designing tools (questionnaires) for the maize value chain study that are gender inclusive		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	The following target sites/villages in Kongwa, Kiteto and Iringa will be used: Ismani, Igula, Kihorogota, Ndoela, Mlali, Sagara and also some marketplaces in Dodoma (Kongwa), part of Iringa and Manyara (Kiteto)			
Start date	October 2018			
End date	September 2019			
Justification: See Protocol # 2 (Appendix 1)				
Objectives: See protocol # 2 (Appendix 1)				
Research questions: See Protocol # 2 (Appendix 1)				
Experiment design, implementation and data analysis: See Protocol # 2 (Appendix 1 & II)				
Data (with metrics) to be collected and uploaded on Dataverse				
				Responsible institution
Productivity:				CIMMYT

Information on Yield (kg/ha) maize varieties grown through survey interviews with producers/farmers (*Please refer to appendix I, protocol # 2*)	
Environmental: Plant diversity (varieties). Types of varieties grown by farmers in target areas. Information to be collected through interviews with farmers/producers during surveys (*Appendix I, protocol # 2*)	CIMMYT
Economic: Profitability/Gross margins (USD), nutrient dense maize vs regular maize, consumer information (demand), input supply information, grain market information, producer information in the VC (*Appendix 1, protocol # 2*)	CIMMYT
Social: Equitable participation (Gender equity) in production, input supply, and grain marketing chains, collective groups (*refer to protocol # 2, appendix 1*)	CIMMYT
Human Condition: Nutrition awareness, Community awareness on nutrient-dense maize varieties, supply; capacity of the community to participate in the production, input supply and grain market *(refer to appendix I, protocol # 2)*	

Deliverables:	Means of verification	End date
1. Information on main actors on production, input supply, and market participation known	Project progress reports, survey reports	20 Sep. 2019
2. Information on seed demand is known		
3. Diversity of maize varieties grown by farmers known		
4. Profitability of nutrient-dense hybrids vs regular hybrids analyzed	Gross margin analysis results	20 Sep. 2019
5. Information on equitable participation in production, input supply, seed demand, and market participation known		
6. Community awareness, Community Knowledge about production, input supply and market opportunities known	Survey reports	20 Sep. 2019

How will scaling be achieved? Results from the survey will inform and be utilized in subsequent activities such as developing VCA enhancement strategy, mapping key stakeholders, identifying market niches and potential for market development.
How are the activities in this protocol linked to those of others? Activities proposed by others are also associated/ linked to production, input supply, consumer and markets chains. Activities in this workplan will provide insights on key players or drivers on production, input supply, consumer and markets and information generated could relevantly help in scaling process of potential technologies being developed for maize in ESA by other researchers under AR support. This activity will be implemented in close collaboration with the VCA activity on small grains and legumes to be carried out by ICRISAT by addressing some of the questions on how the formal seed sector (maize) functions vs the informal seed sector (small grains and legumes) and lessons learned from each system could help improve the other

Outcome 4: Functionality of markets, institutions, and partnerships associated with SI technologies through providing mechanisms that improve household linkages to markets improved		
Output 4.1	Access to profitable markets for smallholder farming communities and priority value chains facilitated	
Activity 4.1.1	Conduct comprehensive value-chain analysis with a specific focus on SI technologies	
Sub-activity 4.1.1.1	**Value chain analysis of groundnut seed and design of operation enhancement strategies for semi-arid ecologies of central Tanzania**	
Systems research team:		
Name	**Institution**	**Role**
James Mwololo	ICRISAT (PI)	Coordinate assembly of data from both research and monitoring activities. Engage with other Africa RISING local and CGIAR partners
Anicet Sambala	IITA	To support the monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading of data into the FtF data management system
Extension officers	DAICOs-Iringa, Kiteto, Kongwa	Support the survey teams (enumerators) as appropriate
Location(s):	Kongwa, Kiteto, Iringa: Chitego and Mlali Njoro or Kiperesa and either Laikala or Moleti and Igula	
Start date	2019	
End date	2019	
Justification: See protocol 3 and the study described therein		
Objectives: See protocol 3 and the study described therein		
Research questions: See protocol 3 and the study described therein		
Experiment design, implementation and data analysis: See protocol 3 and the study described therein		
Data (with metrics) to be collected and uploaded on Dataverse		
Domain		Responsible institution
***Productivity*:** • Crop productivity: Seed yield (kg/ha/season)		ICRISAT
***Environmental*:**		
Economic:		ICRISAT

• Profitability: Net income ($/crop/ha/season), Gross margin, Net income (total net income from strengthened seed value chain projected/quantified)	
Social: • Collective action: Participation in a collective action group in seed production and marketing; Capacity of groups to produce and market seed, Capacity of groups to engage in seed production • Equity: Access to resources, Capacity (access to info), Achievements (income, nutrition, food security, health, well-being), Value chain actor's perception on the importance of quality seed • Social cohesion: Level and reliability of social support in seed production, Incidence of social support in the seed value chain	ICRISAT
Human Condition: • Capacity to experiment: No. of new practices being tested, % of farmers experimenting	ICRISAT

Deliverables:	Means of verification	End data
Groundnut seed value chain assessed and strategic areas for value chain strengthening identified	Study report and draft manuscript	30 Sep. 2019

How will scaling be achieved?
Through partnerships with government, the private sector and development partners to address the seed production gaps identified
How are the activities in this protocol linked to those of others?
Multi-team participation leveraged for enhancing synergies between in the maize and groundnut seed value chains

Outcome 5

Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized		
Output 5.1	Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies	
Activity 5.1.1	Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations	
Sub-activity 5.1.1.1	**Explore the productivity domains of selected legumes and cereals to elucidate their best fitting cropping system at community/landscape level and their dissemination**	
Systems research team:		
Name	**Institution**	**Role**
Patrick Okori	ICRISAT (PI)	Coordinate the assembly of data from both research and monitoring activities
Anicet Sambala	IITA	To provide support in monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading of data into the FtF data management system
TARI technicians/ Extension officers	ARI Hombolo/Iringa, Kiteto, Kongwa, DAICO offices	Backstop field days and other limited field monitoring activities as required
Location(s):	Kongwa, Kiteto, Iringa: Chitego and Mlali, Njoro or Kiperesa and either Laikala or Moleti and Igula	
Start date	2019	
End date	2019	
Justification: See protocols 1.1 and 1.2		
Objectives: See protocols 1.1 and 1.2		
Research questions: See protocols 1.1 and 1.2		
Experiment design, implementation and data analysis: See protocols 1.1 and 1.2		
Data (with metrics) to be collected and uploaded on Dataverse		
		Responsible institution
Productivity: • Crop productivity: Yield (kg/ha/season) • Crop biomass productivity: Residue production (kg/ha/season)		ICRISAT

• Input use efficiency: Product per input	
***Environmental*:** • Fuel availability: Fuel biomass (e.g., wood, residues) produced on plot, % household fuel by type (wood, charcoal), participatory exercise Biomass measurement • Plant biodiversity: Alpha Diversity Index • Pesticide use: Active ingredient/ha	ICRISAT
Economic: • Profitability: Net income ($/crop/ha/season) • Labour requirement (hours/ha)	ICRISAT
Social:	ICRISAT
Human Condition: • Capacity to experiment: Number of new practices being tested, % of farmers experimenting	ICRISAT

Deliverables	**Means of verification**	**End date**
Performance of superior varieties in target communities established to inform technology scaling-up and integration	Report on variety performance (grain yield, net economic benefits).	30 Sep. 2019
Performance of different legume-cereal cropping systems in three sub-ecologies of the Semi-Arid zone of central Tanzania established	Progress reports, draft manuscript for publication in peer-reviewed journal	30 Sep. 2019
Technologies out scaled and upscaled	Number of field days held; Number of farmers directly involved; Partners engaged	30 Sep. 2019

How will scaling be achieved?

Through partnerships with government and development partners to promote the technologies widely postr the project
Through field days and promotional compaigns

How are the activities in this protocol linked to those of others?

A multi-team participation will be used leveraging on complementarities and to explore the synergies among GIS (IITA), soil and water conservation (Hombolo) and integrated soil fertility management (SUA) protocols of teams working in KK

Project Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized	
Output 5.1	Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies
Activity 5.1.2	Use farm trial data to apply crop simulation models (APSIM) and assess performance over space and time, including assessment of climate-smart technologies to establish the potential for adaptation and mitigation
Sub-activity 5.1.2.1	**Crop simulation modelling with APSIM to explore medium to long term SOC, and resource use efficiencies in intercropping systems**

Systems research team:				
Name	Institution	Role		
Amos Ngwira	ICRISAT	PI (post-doc), Simulation modelling postdoc activities		
Anthony Whitbread	ICRISAT	Backstop crop growth modelling		
Sieg Snapp, Regis Chikowo	MSU	Co-supervision of postdoc		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	All sites			
Start date	March 2017			
End date	November 2019			
Justification: See Protocol I				
Objectives: See Protocol I				
Experiment design, implementation and data analysis: See Protocol I				
Data (with metrics) to be collected and uploaded on dataverse				
			Responsible institution	
***Productivity*:** Simulated crop yields (kg/ha/season) for maize, groundnut, soyabean, pigeonpea) in different environments			ICRISAT	
Environmental: Simulated SOC content (%) in crop sequences			ICRISAT	
Economic: Profitability inferred from simulated crop yields (gross margins $/ha)			ICRISAT	
Social: NA				
Human Condition: Protein production (g/ha) inferred from simulated grain yields			ICRISAT	
Deliverables:	Means of verification		End date	
• Calibrated model and simulation runs completed	Draft publication		September 2019	
How will scaling be achieved?				
Link with empirical evidence from field trials to produce technology brief for the extension system Scientific publication in appropriate agricultural systems journal for wider dissemination to the scientific community				
How are the activities in this protocol linked to those of others?				
Parametrization of the APSIM model is based on crop, soils and weather data drawn from other sub-activities of the Africa RISING Malawi project.				

Activity 5.1.2	Use farm trial data to apply crop simulation models and assess performance over space and time, including assessment of climate-smart technologies to establish the potential for adaptation and mitigation	
Sub-activity 5.1.2.1	Apply APSIM crop simulation model to assess changes in resource use efficiencies, productivity and profitability of the different cropping systems in Kongwa, Kiteto and Iringa in Tanzania	
Systems research team:		
Name	**Institution**	**Role**
Amos Ngwira	ICRISAT (PI)	Coordinate assembly of data from both research and monitoring activities. Engage with other Africa RISING agronomists for cross-site studies
Anicet Sambala	IITA	To provide support in monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading of data into the FtF data management system
TARI Technicians/ Extension Officers	ARI Hombolo/Iringa, Kiteto, Kongwa, DAICO offices	Backstop field days and other limited field monitoring activities as required.
Location(s):	Kongwa, Kiteto, Iringa: Chitego and Mlali, Njoro or Kiperesa and either Laikala or Moleti and Igula	
Start date	2019	
End date	2019	
Justification: See protocol 2 and the experiment described therein		
Objectives: See protocol 2 and the experiment described therein		
Research questions: See protocol 2 and the experiment described therein		
Experiment design, implementation and data analysis: See protocol 2 and the experiment described therein		
Data (with metrics) to be collected and uploaded on Dataverse		
These will be generated through simulation	Responsible institution	
***Productivity*:**	ICRISAT	

• Crop productivity: Yield (kg/ha/season) • Crop biomass productivity: Residue production (kg/ha/season) • Input use efficiency: Product per input		
***Environmental*:** • Fuel availability: Fuel biomass (e.g., wood, residues) produced on plot • Soil physical quality: Bulk density • Soil chemical quality: Soil nutrient levels	ICRISAT	
Economic: • Profitability: Net income ($/crop/ha/season) • Labour requirement (hours/ha)	ICRISAT	
Social:		
Human Condition:		
Deliverables:	**Means of verification**	**End data**
Long term implications of intercropping systems on climate and market risks and resource use efficiency of smallholder farms assessed	Reports/publication/extension materials	30 Sep. 2019
	Report on the number of candidate crops and their agronomy options	30 Sep. 2019
Farmer perceptions on technology options	Report on prioritized farmer technology preferences	30 Sep. 2019
How will scaling be achieved?		
Through partnerships with government, researchers and development agencies to adapt modelling insights into sustainable intensification technologies Through publication for further use of the knowledge in program designs		
How are the activities in this protocol linked to those of others?		
Multi-team participation will be adapted during the implementation process to explore the synergies on modelling among GIS (IITA), soil and water conservation (Hombolo) and integrated soil fertility management (SUA) protocols of teams working in KK		

Output 5.1	Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners			
Activity 5.1.4	Demonstrate the use and impact of crop residues, forages, and other organic resources as animal feed and nutrient resources			
Sub-activity: ILRI Dairy 2	Engage development partners to determine which technology they are interested in / or currently engaged in and would like to take to scale (including financially supporting the process) ILRI role will be to develop their capacity in the ability to understand, demonstrate and scale the technology and back-stop their scaling if necessary, and address research needs as they are identified in the process.			
Systems research team:				
Name	Institution	Role		
Ben Lukuyu	ILRI	PI		
Leonard Marwa	TALIRI – West Kilimanjaro	Technical backstopping on preparing and delivering livestock messages		
Extension representative	Extension staff – Babati district	Monitor and provide intelligence about partner activities		
Development partners	World Vision COSITA, FIDE	Training on our technology packages using our training materials.		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	All villages			
Start date	2018			
End date	2020			
Justification: See Protocol				
Objectives: See protocol				
Research questions: See Protocol				
Experiment design, implementation and data analysis: See Protocol				
Data (with metrics) to be collected and uploaded on Dataverse				
			Responsible institution	
***Animal/Plant Productivity*:**				
***Environmental*:**				
Economic:				
Social:				
Human Condition:				

Deliverables:	Means of verification	End date
Meetings with selected partners	Meeting reports and activity outlines for partners	March 2019
Monitoring of training activities	Training reports from partners	July 2019
Number of technologies taken to scale	Report to IITA	
MoU with at least one development partner for a longer-term relationship	Report to IITA	August 2019
Misisng part		

Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized				
Output 5.1	Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies			
Activity 5.1.6	Disseminate best-fit integrated crop-livestock technologies to reach and have effect on small-scale farmers in a landscape context			
Sub-activity – WUR 1	Small-scale piloting of FarmMATCH – a framework for typology-based targeting and scaling of agricultural innovations. (Matching Agricultural Technologies to Farms and their Context)			
Systems research team:				
Name	**Institution**	**Role**		
J. Groot	WUR	PI		
VACANCY	WUR	Junior computer scientist for programming algorithms and data experiments		
F. Muthoni	IITA	Implementation and technical backstopping on data and recommendation domains		
B. Haile	IFPRI	Technical backstopping on farm typology data		
C. Azzarri	IFPRI	Technical backstopping on farm typology data		
L. Claessens	IITA	Technical backstopping on data collection and recommendation domains		
Student(s):				
Name	Institute	Degree	Start	End
J.M. Delore	WUR	MSc	Apr. 2019	Sep. 2019

Location(s):	Babati (multiple villages) [additionally linked to Ghana, three northern regions, multiple villages]
Start date	2019
End date	2021

Justification:

Increasingly, mobile phones and other ICT services are used to provide information and advice to farmers to facilitate learning, but support to targeting and scaling of agricultural technologies through ICT tools is scarce. ICT-based targeting and scaling approaches should not be considered a silver bullet, although they can increase the reach and reduce the costs of technology dissemination compared to traditional village extension services. The actual adoption process and the implementation of new technologies should be supported by extension, training and teaching materials, and by enabling policies and institutional settings (Hermans *et al.* 2012; Wigboldus *et al*. 2016).

Sophisticated models of technology integration in farming activities exist, but they are often very data intensive and do not extend beyond the farm level (Le Gal *et al*. 2011). Muthoni *et al*. (2017) utilized spatially-gridded biophysical and socio-economic layers to generate what they called "sustainable recommendation domains" (SRDs) that could be targeted for scaling specific technologies. Rubiano *et al*. (2016) applied extrapolation domain analysis to find areas with biophysical conditions similar to those observed in the pilot sites where SI technologies have been tested. However, these recent attempts do not consider the suitability of the technologies at the household level. Farm- and household-level variation in socio-economic characteristics (e.g. education levels) is often excluded due to limitations in the granularity of the spatial datasets used: the heterogeneity of households and farming systems within each spatial pixel is not adequately captured owing to the relatively coarse resolution of the spatial input data. The effectiveness of the suitability assessment can be further refined as long as the features of individual farms are considered and directly related to technology characteristics during the targeting phase. Innovations in coupling knowledge among site characteristics, household features and technology attributes with the SRDs is needed to guide spatial targeting of suitable technologies.

Objectives:

The FarmMATCH approach (see concept note here) explicitly tries to fill this knowledge gap, facilitating the matching between agricultural technologies to farms and their context. It contains: 1) a learning and matching algorithm that identifies the most suitable and promising technologies for different farm types; and 2) a data mining and signaling algorithm that identifies hotspots of suitability of technologies and potential adopters. The matching algorithm combines contextual, farm and technology characteristics to create a ranking of the suitability and adoption probability of available innovations. The data mining and signaling algorithm monitors the generated technology rankings and recommendations made to farmers. When the frequency of recommendations for a particular technology strongly increases in space or in time FarmMATCH issues a signal that a hotspot has been identified. In turn, this identification triggers spatially-tailored policy analysis, such as additional incentives and interventions to provide innovation support to enhance information exchange among farmers; supply chain development; availability of financial arrangements.

Research questions:

- What are the most suitable and promising technologies for different types of farms?
- Where are the hotspots of suitability of technologies and potential adopters?
- Which contextual farm and technology characteristics promote the adoption and scaling of technologies?

Experiment design, implementation and data analysis:

- Creation and further development of spatially-gridded biophysical and socio-economic layers used to generate "Sustainable Recommendation Domains"
- Development of the learning and matching algorithm that identifies which of the technologies tested and promoted by Africa RISING and its partners are most suitable and promising for different farm types in a given biophysical and socio-economic context.
- Development of hand-held app and mirrored website for collection of geo-referenced farm data (8-10 variables).
- This approach will be piloted for ca. 10 grid cells in Tanzania (Babati). (Separately a similar assessment could be conducted in Africa RISING West Africa, northern Ghana.)

Data (with metrics) to be collected and uploaded on Dataverse. It should be noted that this activity does not aim to quantify the performance of farming systems in terms of the SIA indicators. Data collected are used to determine suitability to target innovations. Methods will be aiming at rapid data collection, and avoid time-consuming deeper analysis. However, follow-up research could be triggered based on signaling of variable values and technology suitability.

	Responsible institution
***Productivity*:** Crops productivity; cropping intensity	WUR
***Environmental*:** Water availability and quality; soil cover; erosion; soil physical quality; soil chemical quality	WUR
***Economic*:** Profitability; income diversification; market participation	WUR
Social: Equity; collective action	WUR
Human Condition: Food security; nutrition	WUR

Deliverables:	Means of verification	End date
Report describing the experiment and algorithms performance	Report	30 Sep. 2019
Coded algorithms for matching and signalling	Code	30 Sep. 2019
Data for grid cells and generated recommendations	Data	30 Sep. 2019

How will scaling be achieved?

The tool is potentially completely scalable, and could be used by all farmers through their mobile device. Moreover, through the signaling function, it allows the identification of sites where extra support for scaling is needed in terms of market development, extension delivery, etc.

How are the activities in this protocol linked to those of others?

This sub-activity is linked to:

- Activity 1.4.1 Conduct extrapolation domain analysis based on GIS, agroecology, and crop model-generated information to establish the potential of technologies for geographical reach

- Sub-activity 1.4.1.1 Produce regionally relevant extrapolation domain maps for validated technologies (vegetable varieties, forage cultivars, maize and fertilizers and conservation agriculture practices).

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Output 5.2	Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products established			
Activity 5.2.2	Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways			
Sub-activity –5.2.1.1	**Engage with seed companies to accelerate QPM seed scaling**			
Systems research team:				
Name	Institution	Role		
Bright Jumbo	CIMMYT	PI		
Anicet Sambala	IITA	To provide support in monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading into the FtF system		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	Dialogue with seed companies covering Arusha, Dodoma, Iringa			
Start date	**October 2018**			
End date	**September 2019**			
Justification: See Protocol (*Appendix 1*, *Appendix 1, protocol # 3*)				
Objectives: See protocol (*Appendix 1, Appendix 1, protocol # 3*)				
Research questions: See Protocol (*Appendix 1*, *Appendix 1, protocol # 3*)				
Experiment design, implementation and data analysis: See Protocol (*Appendix 1, protocol # 3*)				
Data (with metrics) to be collected and uploaded on Dataverse				
This activity will allow presenting data from previous experiments during meetings for review and generate information on other domains as indicated below (please refer to protocol # 3)			Responsible institution	
***Productivity*:**			CIMMYT	
***Environmental*:**				

Economic:	
Social: Seed companies/agrodealer links enabling agrodealers participation in seed distribution or trade	
Human Condition: The capacity of seed companies and agrodelars to engage in the seed business, collective action	

Deliverables:	Means of verification	End date
1. MoUs with interested seed companies	Project progress reports, MoUs	Aug. 2019
2. Promotions on QPM	Company field planning reports	Aug. 2019
3. Increased interest in participation in AR field days by seed companies	Field day reports	Aug. 2019

How will scaling be achieved? This activity is part of the scaling process and successful engagement with the private seed companies has the potential for an increase in investment in QPM seed production/commercialization that could lead to increased access by farmers and increased adoption.
How are the activities in this protocol linked to those of others?
Technologies on soil and water conservation and good agronomic practices are very critical support to maximize variety productivity potential, therefore approved/recommended new technologies on soil and water conservation as well as good agricultural practices will be packaged and linked to both QPM seed production by seed companies and QPM grain production by farmers at farm level

Output 5.2	Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products established	
Activity 5.2.2	Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways	
Sub-activity 5.2.2.2	**Engage able and willing partners to develop a strategy and implementation framework for scaling up intensification technologies in semi-arid ecologies of central Tanzania**	
Systems research team:		
Name	**Institution**	**Role**
James Mwololo	ICRISAT (PI)	Lead engagement activities with partners as well coordinate assembly of data
Anicet Sambala	IITA	To provide support in the monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and

		Custom indicators data) with a critical gender perspective and uploading of data into the FtF data management system
Extension officers	DAICO-, Kiteto, Kongwa	Backstop the AR and private sector as appropriate
Location(s):	Kongwa, Kiteto, Iringa: Chitego and Mlali, Njoro or Kiperesa and either Laikala or Moleti and Igula	
Start date	2019	
End date	2019	
Justification: See protocol 4 and the activities described therein		
Objectives: See protocol 4 and the activities described therein		
Research questions: See protocol 4 and the activities described therein		
Experiment design, implementation and data analysis: See protocol 4 and the activities described therein		

Domain	Responsible institution
Economic: • Profitability: Net income ($/crop/ha/season), Gross margin	ICRISAT
Social: • Social cohesion: Incidence of social support to value chain and IPs by partners and stakeholders	ICRISAT
Human Condition: • Capacity to experiment: Number of farmers experimenting, the percentage of women and men using the new technologies- assessed through surveys, focus group discussion, Number of new practices adopted, Technical capacity of partners	ICRISAT

Deliverables:	Means of verification	End data
Partnerships explored to improve delivery of underinvested legumes (groundnut) and cereals (sorghum)	Meeting Reports Partnership MoUs Study reports	30 Nov. 2019
Imperatives for leveraging synergies of the private sector working with local communities to improve access to seed investigated.	Study report	30 Nov. 2019

How will scaling be achieved?
Through partnerships with government, the private sector and development partners to spearhead the scaling of technologies and innovations post-project
How are the activities in this protocol linked to those of others?

Multi-team participation will be adapted during the implementation process to ensure collective action for up-scaling and dissemination of technologies developed by the different institutions in the consortium

Output 5.3	Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners	
Activity 5.3.1	Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies	
Sub-activity 5.3.1.1	**Role of gender from farm-to-fork and the market, of grain legumes and dryland cereals in Kiteto and Kongwa**	
Systems research team:		
Name	**Institution**	**Role**
Esther Njunguna	ICRISAT (PI)	Coordinate assembly of data from both research and monitoring activities. Engage with other Africa RISING local and CGIAR partners
Wanjiku Gichohi	ICRISAT (Co-PI)	Coordinate assembly of data from both research and monitoring activities.
Yacinta Muzanila	SUA (Partner)	Support the assembly of data from both research and monitoring activities
Gundula Fischer	IITA	Backstopping design of studies and works with ICRSAT Social Scientist
Anicet Sambala	IITA (ESA M&E)	To provide support in monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and Custom indicators data) with a critical gender perspective and uploading of data into the FtF data management system
Location(s):	Kongwa, Kiteto, Iringa	
Start date	2019	
End date	2019	
Research questions: See protocol 5 and the study described therein		
Objectives: See protocol 5 and the study described therein		
Research questions: See protocol 5 and the study described therein		
Experiment design, implementation and data analysis: See protocol 5 and the study described therein		

Domain	Responsible institution
Economic: • Poverty: Income and asset distribution by gender	ICRISAT/SUA
Social: • Gender equity: Index on women empowerment in Agriculture	ICRISAT/SUA

• Equity: Access to resources, Capacity (access to info), Achievements (income, nutrition, food security, health, well-being) • Social cohesion: Incidence of social support in farming with a gender focus	
Human Condition: • Food Security: Food availability, accessibility, and utilization • Nutrition: Access to nutritious foods, Dietary diversity, Food consumption score, Nutritional status **NB: Measures through** Survey, Lookup tables, Anthropometric measurements, Participatory mapping	ICRISAT/SUA

Deliverables:	**Means of verification**	**End data**
Gender analysis study guided conducted	Report	30 Sep. 2019
Gender decision support tools on the role of women in nutrition and health developed	Report	30 Sep. 2019
Scaling and linkages		

Output 5.3	Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners			
Activity 5.3.1	Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies			
Sub-activity: ILRI Dairy 3	Farmer/Extension messaging (forage production and use, crop residue processing and use and feed rations) using MWANGA			
Systems research team:				
Name	Institution	Role		
Ben Lukuyu	ILRI	PI - develop livestock and feed messages, assess effectiveness of these messaging		
Leonard Marwa	TALIRI – West Kilimanjaro	Technical backstopping on preparing and delivering livestock messages		
Mr. Mbesere	Extension staff – Babati district	Cross-check and translate messages		
	ESOKO	Messaging		
	IITA	Develop food safety messages		
	Development partners (COSITA, World Vision)	Intelligence of farmer messaging monitor farmer feedback		
	ILRI	Develops Integrated soil/fertilizer messages		
Student(s):				
Name	Institute	Degree	Start	End
Location(s):	All villages			

Start date	2018
End date	2020

Justification: See Protocol

Objectives: See protocol

Research questions: See Protocol

Experiment design, implementation and data analysis: See Protocol

Data (with metrics) to be collected and uploaded on Dataverse

	Responsible institution
Productivity: ***Animal Productivity*** - Animal products (amount /animal /year). - Animal by-products (amount /animal /year) - Rating of animal productivity	ILRI
Economic: ***Labor requirement*** - Labor requirement (hours/day) - Farmer rating of labor	ILRI
Social: ***Equity*** - Rating of technologies by group	ILRI
Human Condition: ***Capacity to experiment*** - # of new practices being tested - % of farmers experimenting	ILRI

Deliverables:	Means of verification	End date
Baseline survey of current Knowledge, Practices and Attitudes amongst farmers before intervention	Project report to IITA	March 2019
At least 10 messages to farmers and extension staff about improved technologies disseminated through SMS	Project report to IITA with message content and dates	July 2019
End line survey to measure change in Knowledge, Practices and Attitudes from target farmers	Project report provided through quarterly reporting	August 2019
Complete data analysis	Project report to IITA	August 2019
Report to IITA about sub-activity completion	Report	September 2019

How will scaling be achieved?
Partnership with COSITA and World Vision to reach about technology to 200 farmers through the platform
How are the activities in this protocol linked to those of others?
Forages as feed and land management strategy will be highlighted